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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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NOTES AND COMMENTS.

The Use of Synthetic Pig.

Owing to the scarcity and cost of pig-iron, some foundries have been going abroad for supplies, and should they be tempted to buy synthetic pig-iron for use in the converter, we would advise extreme caution, owing to serious variations in composition. This question has been tackled in a very exhaustive manner by M. Evence Lecron, and details of his tests are given in the July number of "La Fonderie Moderne." His experiments were conducted in a 10-ton Bessemer converter, and were spread over a year's work. He sums up his results by stating that in general French electrically-manufactured synthetic pig-irons are very pure as regards sulphur, but very liable to be too contaminated with phosphorus to give good results when manufacturing steel castings by the acid Bessemer or acid Siemens processes. Whilst the manganese is correct and suitable for the baby Bessemer, it is occasionally too low and naturally associated with a high percentage of sulphur. The silicon is very unsteady, and it becomes extremely annoying when this results in the blown steel being either too hot or too cold, to which there is to be added the casting difficulty.

The phosphorus is equally irregular, and within half an hour what should have been an identical mixture has given both good and bad castings.

He suggests that the manufacturers of synthetic pig-iron should employ larger furnaces, or those factories having many small furnaces, a mixer, in order that a uniform quality might be produced. The manufacturers should classify their raw material (turnings) according to the phosphorous contents, and should immediately reject any material likely to be contaminated with zinc, copper or tin, as considerable quantities of these elements have several times been found to be present.

M. Lecron tenders the following advice to French purchasers of synthetic iron, and naturally this will be equally applicable to British importers. If the material is to be used for making castings by the small Bessemer process, the buyer should insist on a minimum of 2 and a maximum of 3 per cent. of silicon. Many foundrymen imagine that by purchasing a high silicon iron they can economise by diluting the charge with scrap. This is not to be recommended, as bought scrap is too irregular as regards sulphur, phosphorus and oxide, and the gain shown on paper will be more than neutralised by rejected castings.

The manganese content should be about 1 per cent., and the sulphur should be specified not to exceed 0.05 per cent. The phosphorus, though usually allowed up to a maximum of 0.08 per cent., should be lowered down to 0.06 per cent. in order to guard against heterogeneity. On arrival, each truck should be carefully sampled, and all pigs contaminated with slag should be returned, as this slag is often very phosphoric. Classified storage of each arrival is essential, as no special texture is shown by synthetic pig. For acid Siemens furnace use all the above equally applies, except that the manganese content should be at least 2 per cent., and for basic Siemens furnace use the following specification is laid down:—Silicon, 1 per cent.; manganese, 2 to 3 per cent.; sulphur, 0.05 per cent., maximum; and phosphorus, 0.20 per cent., maximum. When using such iron in the basic furnace it is advisable not to charge it directly on to the furnace hearth, for if a portion is too silicious it will eat into the hearth, resulting in the usual fettling troubles.

From the above it would seem that synthetic iron is not to be recommended, but such is not the case providing a reliable source of supply is found. It has many features worthy of consideration, and its only fault is that associated with the production of many small lots, or, in other words, irregularity.

The use of synthetic iron for steel-making purposes has been developed owing to the economic situation developed during and since the war, which has rendered the purchasing of foreign pig-irons almost prohibitive for the French, and in all probability they will revert to the former sources of supply, and this may result in increased efforts to place synthetic iron abroad.

Judging, however, by the excellent reputation enjoyed by synthetic iron for cast-iron castings in France, no founder need hesitate in using this material for such a purpose, providing he can procure the correct type.

Index to Vol. XXII, for 1920.

The index for last year's FOUNDRY TRADE JOURNAL is now ready, and can be had on application to the Editor. We have departed from the usual course of including it with an ordinary issue, owing to the change in size of the JOURNAL.

"The General" Hand-Operated Moulding Machine.

The primary object of the design of the machine illustrated was to provide a deep, accurate and variable draw. Even when moulding comparatively simple castings, pattern drawing is the work of a skilled moulder although the whole of the other operations concerned are well within the scope of unskilled labour, so that the small foundry is often at a considerable disadvantage insomuch as the foundry output does not justify the installation of power-operated machines, hitherto, therefore, such foundries have been unable to employ profitably unskilled or even semi-skilled labour in the moulding shop.

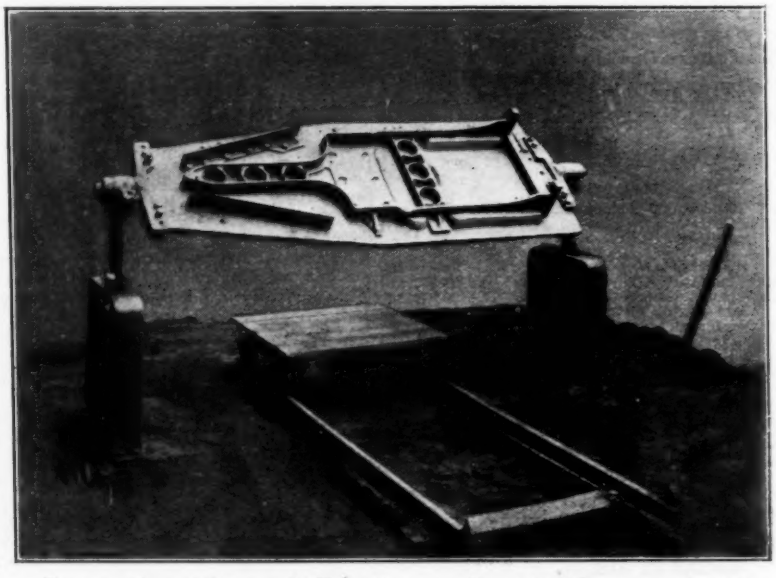

FIG. 1.—THE "GENERAL" HAND-OPERATED MOULDING MACHINE, SHOWING THE LARGE AMOUNT OF DRAFT OBTAINABLE.

The machine, simple alike in construction and operation, appears likely to prove a valuable asset to the small foundry, and is at the same time equally suitable for service in the largest foundries, in point of fact, in the Leicestershire foundry, where our photographs were taken, 24 of these machines of various sizes were in operation. It will also be obvious from our description that though designed as a hand machine, it lends itself readily to the application of power. The machine is equally suitable for ferrous and non-ferrous foundries.

In the first place, it will be seen that the vertical shafts by which the pattern plate is raised and lowered, instead of being operated from their bottom extremities by short toggles are raised and lowered by comparatively long connecting rods, hinged to an intermediate part of the shafts at their upper ends, whilst their lower ends are connected with long cranks on the horizontal crank-shaft. By this means the effort required to raise or lower the pattern plate is considerably reduced, while, at the same time, a much deeper draft is possible. The standards, in which the vertical shafts are adapted to reciprocate, are adjustably mounted over the pit, so that work of various sizes may be readily accommodated.

In order to provide for a variable draw the operating hand lever is provided with a rack and pawl device, so that the amount of draft can be regulated at will, according to the depth of pattern and amount of clearance necessary.

An important feature, which has a further influence on the manipulation of the machine, is the method of counterbalance employed.

The lower ends of the vertical shafts are supported by stirrup bars, to each end of which a wire rope is attached. These ropes run upwardly and pass over jockey pulleys, which are mounted in bearings in the standards, and have their free ends to which a counter weight is attached, hanging down into the pit. The weights may, of course, be varied at will. In the larger machines a saddle is suspended between the balance ropes which can be loaded up with pig-iron or the like so as to balance any particular weight of plate.

The pattern plate is carried by brackets mounted on trunnions carried to the upper ends of the vertical shafts. To ensure a perfectly accurate draw, which is particularly desirable in a deep draft, the pattern plate is locked in a plane truly at right angles to the axis of the vertical shafts. For this purpose the upper ends of the standards are provided with pivoted trip stops and locking catches in such a manner that when the plate is turned in one direction lugs on one end of the brackets trip past the pivoted stops and take a bearing on the upper faces of the latter. This prevents the plate turning in the opposite direction and past the horizontal plane. The plate is then firmly locked in this position by turning the locking catches into engagement with the lugs on the other ends of the brackets.

FIG. 2.—A SMALLER TYPE OF THE "GENERAL" MOULDING MACHINE, SHOWING METHOD OF CARRYING THE PATTERN PLATE.

The standards are provided with the customary tram rails for the moulding box trucks. The machines are manufactured by the General Foundry and Engineering Company, Limited, Lutterworth, Leicestershire.

High Frequency Furnaces.*

By E. F. Northrup.

Ajax-Northrup high-frequency inductive furnaces for melting practically all metals, and also glass and refractories, any of which may be operated by high-frequency converter sets, can be divided into seven classes:—High temperatures and vacuum type furnaces. Electric crucible type furnaces. Mint-type furnaces. Heat treatment furnaces. Graphitisation furnaces. Miscellaneous heating and muffle type furnaces. Large tilting and pouring-type furnaces.

It is obvious that if the available power is limited to a definite maximum, the highest temperature can be obtained only by restricting the volume of the mass to be heated.

High Temperature and Vacuum Furnace.—The inductor coil of this furnace is made of 42 turns of ⅜-in. flattened copper tubing. The inductor is wound as a solenoid and is 9 in. long and 4 3-16 in. in inside diameter. The high frequency potential is applied to the terminals of this solenoid and also a water pressure of 30 lbs. or more, which maintains a flow of water through the flattened tubular solenoid. The furnace may be used as a vacuum or as a non-vacuum furnace. It is of the non-tilting type, and its contents are removed through the bottom by withdrawing a slide of asbestos board. This type of furnace under favourable conditions will melt molybdenum and can be used to melt electro-

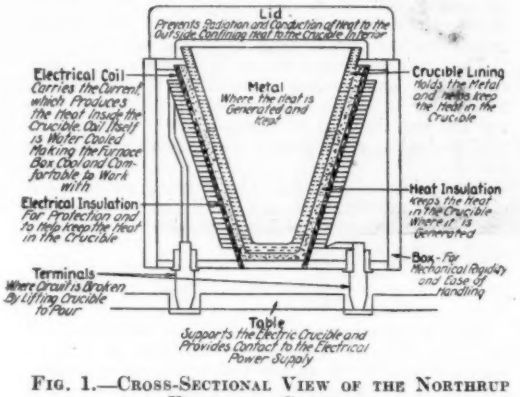
Lid
Prevents Radiation and Conduction of Heat to the Outside, Confining Heat to the Crucible Interior
Electrical Coil
Carries the Current which Produces the Heat Inside the Crucible. Coil Itself is Water Cooled Making the Furnace Box Cool and Comfortable to Work with
Electrical Insulation
For Protection and to Help Keep the Heat in the Crucible
Terminals
Where Circuit is Broken By Lifting Crucible to Pour
Metal
Where the Heat is Generated and Kept
Crucible Lining
Holds the Metal and Helps Keep the Heat in the Crucible
Heat Insulation
Keeps the Heat in the Crucible Where it is Generated
Box - For Mechanical Rigidity and Ease of Handling
Table
Supports the Electric Crucible and Provides Contact to the Electrical Power Supply

FIG. 1.—CROSS-SECTIONAL VIEW OF THE NORTHRUP ELECTRICAL CRUCIBLE.

lytic iron in 5 to 6-lb. lots, strictly carbon free. The furnace is suitable for the recovery of platinum scrap. When a crucible of carbon or graphite of about 2¼ in. inside diameter by 7 in. long is used, and this is heat-insulated with lampblack, it is not difficult to obtain temperatures in from 15 to 20 minutes which are more than sufficient to completely graphitise carbon.

For melting in vacuum, a quartz tube closed at the bottom is used which just fits the coil. This tube is fitted at the top with a water-cooled cover with a connection for exhausting the air. Refractories insulate better under high vacuum conditions, and the highest temperatures are easily obtained in vacuum with an expenditure of ten or fifteen kilowatts.

Electric Crucible Furnaces.—This type of furnace has been constructed in four sizes. The inductor coil and crucible are conical. The furnace sits upon a low table and makes contact with the high-frequency converter terminals by means of two metallic feet.

All furnaces of this type are designed for pouring the metal contents in the same manner in which the contents of an ordinary crucible are poured, over its edge; hence the term *Electric Crucible*. An electric crucible may be lifted by handles, placed on two opposite sides, entirely off the table and poured; or it may be pivoted, around an axis passing through its pouring spout, on trunnions. In this case it is lifted by a handle on the side in the back, and poured.

If it is remembered that all types of furnaces operated by high frequency induction are substantially at room temperature on the outside, the practicability of handling a furnace is readily seen.

The 6-in., 60-kilowatt furnace is well adapted to melting precious metals, especially gold and platinum alloys. The furnace will melt and pour about 10 to 15 lbs. of copper, or about 8 to 10 lbs. of steel. The melting is extremely rapid, and when non-conducting crucibles are used, as would be the case when melting a platinum-gold alloy or a ferrous metal, the molten metal stirs violently—a circumstance which assures the perfect mix of an alloy.

Fig. 1 is a cross-sectional view of an electric crucible in which the crucible is about 10 in. in diameter at its top. It is designed to hold and melt about 50 lbs. of copper or brass and about 50 lbs. of steel. In this case a pour is made by lifting the electric crucible clear off the table on which it rests. The crucible is lifted and tilted for pouring by two persons, using detachable handles.

Twenty-five lbs. of chromium steel have been melted in a non-conducting crucible from steel turnings, hence the carbon content of the steel has not been changed. It required 15 kilowatts and 25 minutes to make this melt, starting with the furnace cold.

For melting pure platinum and iridium free from all contamination, an electric crucible has been made with a conical crucible 5⅛ in. in diameter at its top. This conical crucible is made of moulded silica ware. Fitting in this is the crucible proper, which holds the metal to be melted. This crucible can be moulded of such suitable materials as lime, electrically shrunk magnesia, or the like. The purpose of the outside quartz crucible is to give perfect electrical insulation between the conical inductor coil and the metal contents of the crucible. The melting is, of course, produced by the currents which are generated by the inductor in the metal itself.

In using the above three electric crucibles, in which it may be required to obtain very high temperatures, it has been found advantageous to maintain a flow of water through the inductor coil. The water connections to the coil are made with rubber tubing a metre or more long, and it has been found that the resistance of this length of water column is sufficiently high to prevent the water circuit from acting as a shunt on the electric circuit.

A larger electric crucible without water connections and with a practically cylindrical crucible is, at the date of this writing, under construction. It is designed for melting and pouring brass or bronze in 200-lb. lots. To secure more rapid melting, a 25-kilowatt high frequency single-base converter set will be used. As this type is a recent development, performance data are not yet available.

In the 6 and 10-in. electric crucibles copper melts and superheats to a suitable pouring temperature at the rate of about 4.2 lbs. per kilowatt hour. As will be shown later, the melting rate with larger furnaces and more power is considerably increased; 25 per cent. or more.

Mint-Type Furnaces.—This type of furnace was designed specially for use at the United States mint in Philadelphia, in connection with work carried on in the deposit melting room.

Four furnaces of the same general type have been installed at the mint for over a year, and two of these, according to the annual report of the director of the mint, 1920, "have been operating daily since March 20, 1920, on small deposits, two small crucibles being used to each furnace, which practice has been followed on combustion furnaces for years past." The other two furnaces have more recently been put into continuous operation. "The results of a test run, melting fine silver bars, were as follows:—Total amount melted, 13,478.50 ozs.; total time consumed seven hours; total current used, 156.50 kilowatt-hours; pounds melted per kilowatt-hour, 5.905; average load per phase, 12½ kilowatts. The results will be greatly improved when the capacity of furnaces is reached by having a full quota of

* Extracted from a Paper read at the Atlantic City Convention of the American Electrochemical Society.

condensers, which are now being installed, using 16 kilowatts per phase instead of 12¼. The fuel cost at the rate of consumption shown above compares favourably with gas."

These furnaces are cylindrical, stationary furnaces and are designed for melting metals in a crucible which may be lifted out of the furnace and poured. In the larger furnaces the molten metal is dipped out until only a little remains in the bottom of the crucible. The last portion of metal is removed by then withdrawing the crucible and pouring it out. In the smaller furnaces the metal deposits are placed in small crucibles and lowered into a thin-walled graphite crucible within the furnace, which remains permanently in the furnace. The four furnaces of this type installed at the mint use a total of 48 kilowatts in melting.

Furnace Crucibles—Coated Crucibles.—In high-frequency induction heating of ferrous metals and other metals of high resistivity, as platinum, non-conducting crucibles are used. In melting gold, silver, copper and other metals, which do not tend to take up carbon at a high temperature it is better to employ a machined graphite crucible or a moulded carbon crucible for the purpose.

The single objection to these crucibles has been due in the past to the rapidity with which they oxidise and burn away at high temperature when exposed to the air.

To overcome this defect the writer made a research to find a coating which could be put upon graphite or carbon that would have the following properties:

It must withstand a temperature of 2,000 degrees centigrade at least.

It must be impervious to air at this temperature, at least to the extent that the graphite shall not oxidise beneath the coating and cause it to scale off.

The coating must have a chemical union with the carbon to make it cohere to the carbon tenaciously.

It must be of a nature such that other coatings of the same or other material may be laid over it, and cling tightly. This second coating should be capable of selection such that molten metals, even steel, will not dissolve it.

These results have all been secured. A graphite crucible thus coated will not oxidise when it is at a temperature of 1,800 degrees centigrade and a jet of oxygen is blown upon it.

The foundation coating is put on at a temperature exceeding 2,200 degrees centigrade. An additional coating of zirkite, magnesite, etc., may easily be added as desired.

These coated crucibles are particularly useful in the electric crucibles which may be operated with the cover removed, and the coated crucible freely exposed to the air when hot. These coated crucibles, however, have been made too recently for working life tests with them. It is to be expected that they will have a prolonged life which will make the crucible cost for high-frequency induction furnaces very low.

Heat Treatment Furnaces.—These cannot here be described further than to state that steel of any shape, even thin knife blades, or such commercial products as the cutting knives of lawnmowers, when placed in an inductor coil energised with current having a frequency of 20,000 cycles, is rapidly and uniformly heated to the required temperature. The heating in this case is due largely, and in the case of thin steel sheets almost wholly, to the development of heat by hysteresis loss in the magnetic material.

This type of furnace should have a wide commercial application, though up-to-date furnaces mostly have been constructed for merely demonstrating the principle; one, however, is in commercial operation at the plant of the Cleveland Twist Drill Company, for straightening twist drills.

Sixty Kilowatt Tilting and Pouring Furnace.—A three-phase high frequency converter supplied with condenser units will absorb 60 kilowatts from the supply line, and will deliver from 60 to 70 per cent. of this power to the terminals of a properly constructed furnace. Thus with 40 kilowatts actually supplied to the furnace, or as much as 35 kilowatts in the form of heat to the crucible itself, it is possible and desirable to heat crucibles which hold as much as 600 pounds of silver, or equivalent weights of copper, brass, bronze or other non-ferrous metals which melt under say 1,200 degrees.

To handle and pour this quantity of metal it is advantageous to design the furnace for tilting and pouring through the medium of a heavily constructed mechanism.

The following features were embodied in its design and construction:—

The crucible and inductor coil are housed in a box made of sheet steel 5-16 in. thick. The box is 45½ in. high, 31½ in. wide, and 27⅝ in. deep. The top of the box is fitted with a heavy moulded refractory piece. This has a central hole 10 in. in diameter—the inside diameter of the crucible—and a carefully shaped pouring spout.

The crucible and its steel housing may be rotated for pouring around an axis which passes exactly through the end of the pouring spout. The crucible may be raised in the process of pouring 15 degrees above the horizontal.

The movable portion of the furnace is counterweighted, whereby very little exertion is required to tilt and pour the charge.

The space in front of the spout is free from mechanism, which permits moulds to be brought by a carrier directly beneath the end of the spout.

The furnace is free for approach by a man or a truck from behind, which arrangement gives facility to the charging.

The furnace when in its vertical position makes electrical contact with three leads from the high frequency converter, and when tilted for pouring breaks these contacts with no arcing. The furnace has, therefore, no moving electrical conductors.

The inductor coils, three in number and star-connected, have water circulating through them. The water is led in and out of these coils at the two ends of the axis of rotation of the furnace, by which device all movable water connections are avoided.

The inductor coils and the housing of the crucible and inductor coils are at all times at or near room temperature, which makes the furnace very comfortable to work around.

The crucible is of carbon or artificial graphite. It may be moulded or turned out of a section of 12-in. artificial graphite electrode.

The electrical insulation between inductor coil and crucible is a cylinder of micanite of a ¾-in. wall (and thus is avoided the use of a rather fragile quartz cylinder), which material has been found suitable for many of the small furnaces that have been made.

The performance of this furnace mechanically, electrically and metallurgically appears to be satisfactory. It is capable of continuous operation for eight hours or more and is actually being operated at Handy & Harman, Bridgeport, Conn., throughout a working day. Table I. shows the performance of one day's operation, and may be taken as typical of what the furnace is capable of doing.

TABLE I.—*Report of One Day's Operation of Silver Melting Furnace.*

Melt.	Melting time only. Lb./KWH.	Melting and superheating time only. Lb./KWH.	Material.
1	9 8	8.4	Fine silver and copper.
2	12.3	8.15	Sterling scrap.
3	12.7	10.2	Sterling scrap.
4	12.1	9.7	Sterling scrap.
5	9.4	8.0	Fine silver and copper.
Average	11.3	8.89	

Rate of melting: Average for all the time, 7.95 lbs. per KWH.

It may be said in conclusion that the highly useful possibilities of high frequency inductive heating are broad—provided high frequency power is available in commercial quantities, and at a cost which is not prohibitive. Certain it is that high-frequency converters, of a static character, are now available at reasonable price in single units up to 60 kilowatts, and that these units may be multiplied for operating a single large furnace without undue complication.

Tests have shown that with a suitably designed furnace for a load the efficiencies of these static converters—which operate on the principle of oscillatory currents—are the equal of the best performance of high frequency alternators which have been built.

The "Galeco" Rust-Proofing Process.

The Galvanising Equipment Company, Limited, Portpool Lane, Gray's Inn Road, London, have now standardised the apparatus and system for working the "Galeco" process, in which rust-proofing is brought about by a special chemical and metallic compound which undergoes very moderate heat treatment when in contact with the articles being treated, so that a complete unit can now be installed in a manufacturer's works and rust-proofing be made part and parcel of the works practice.

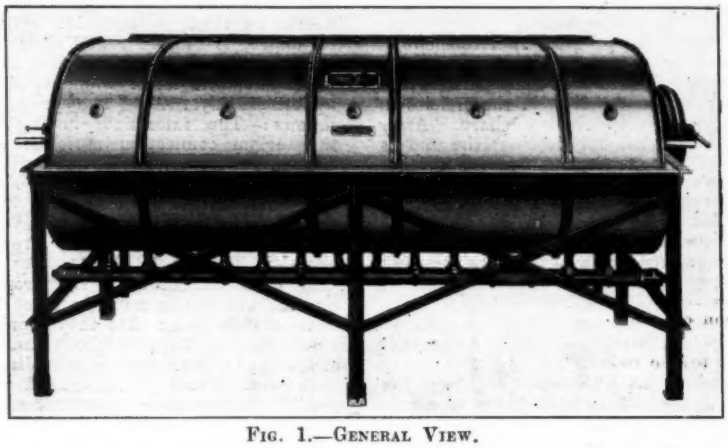

Fig. 1.—General View.

A unit comprises a gas-coke-fired furnace (Fig. 1) to which forced draft is applied for quickly raising the temperature to that necessary for working. The furnace body is constructed of mild-steel framing and heavy-gauge sheet metal, and is lined first with asbestos and then with firebrick, thus providing very effective heat insulation. The hood has asbestos insertion between the construction sheets and is fitted with counter-weights which operate in two directions, so that balance is obtained at all positions. The air-blast tube is arranged under the furnace body and is fitted with air nozzles of special design, carrying iron cones, which pass sufficient air to the fire-grate to support combustion after the blast has been shut off, the forced blast being only used to raise the temperature in the first place. The tuyere tube and flue-box are fitted with dampers, and a suitable temperature indicator is provided.

The container for the material being treated is a mild-steel tube (Fig. 2) to each end of which are welded angle rings slotted for the bolts securing the cover flanges; the latter are heavy castings with a spigot on the inner face which forms a register and support, and ensures centralisation of the flanges on the container body. Trunnion shafts are fixed to the flanges. One of the shafts is slotted across its face for engagement with the dog clutch incorporated with the worm drive on the furnace, and an annular groove on the shaft meshes with a stud in the furnace half bearing

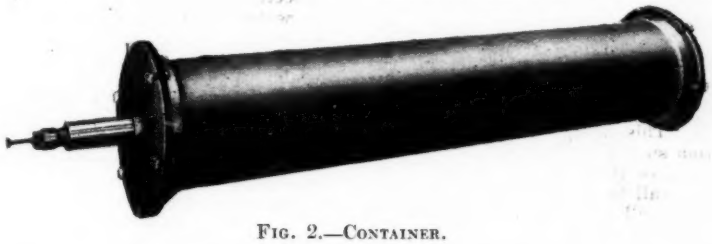

Fig. 2.—Container.

Fig. 3.—Separator.

which, while preventing lateral movement, does not restrict any expansion of the container under heat. The other trunnion shaft has a concentric hole bored through it, which enables a testing device to be used. This device eliminates haphazard operation, and the exact time and temperature can be controlled and adjusted to conform with a periodical inspection. The stuffing box on the free end of the shaft has a detent mounted upon its cap for regulating the withdrawal of the test rod through the hollow shaft.

Determination of the progress in treatment of articles is made by withdrawing the test rod a prefixed distance, which brings that part of the rod which has been immersed (with the articles in the container) within the hollow shaft. After allowing a few moments for cooling, the rod is again withdrawn till the detent prevents further movement. The treated portion is now visible, and the quality of the coat can be ascertained by the practised eye, or by gauge. By the use of the latter it is possible to work to reasonable limits, which is particularly advantageous when treating machined parts. If inspection shows insufficient coating, the rod is slowly pushed back into place till another inspection is made. When the charge is finished the detent is released, the rod removed, and pickled off for re-use.

The container is filled and emptied by the removal of one flange, a ring of asbestos cord providing an effective seal. The container is rotated by a worm reduction gear having a ratio 75:1, fitted in a gear case which also forms a half bearing for supporting the container shaft. The worm-wheel shaft has a dog clutch incorporated, with a plunger operated from a lever mounted on the shroud.

The general structure of the separator will be seen from Fig. 3. A worm-gear case, duplicate to that fitted to the furnace, is mounted at one end of the separator and a hinged hood at the other. When the container of processed material is placed in position, the trunnion shaft for the clutch engagement lies in a half bearing, while the free end of the container rests upon castor wheels, and has its flange under the hood; as the container is at a slight angle, when the flange is removed rotation will cause the material and compound to be fed down a shute into the sieve drum through which the articles travel, the material falling through the mesh to be taken up by a worm conveyor. The drum and worm conveyor are driven by chain from a sprocket mounted upon the reduction worm-wheel shaft. Generally, the material coming from the drum is clean and fit for bagging, though it is sometimes necessary to barrel with sawdust castings having a very rough surface.

Queries Answered.

Electric Furnace Hearths.

Q.1.—What do you consider the best method of lining the hearth of my furnace, of which the casing is 2 metres (6 ft. 7 in.) by 1.5 metres (5 ft.)? The hearth is to be conductive and the capacity 700 kilos. (14 cwts.).—Belgian Foundryman.

Q.2.—The method of establishing the connection is of prime importance, and we would suggest the introduction of copper plate to cover completely the whole bottom plate, though some designs recommend a steel casting, which is carried up the side and through the back wall of the furnace, and there connected with the electric system. Your furnace is sufficiently large to allow of a 9-in. wall to be built as retainers for the refractory material. These should be composed of ordinary firebricks, two courses below the bank level, and above this magnesite squares are necessary, but between the top of the banks and the roof, silicas can be used. It is advisable to have a couple of courses of chrome bricks backed with silicas at the place where the top of banks touch the wall. These walls should be separated from the side plates by an inch air gap, which can afterwards be filled with sand, or, preferably, Kieselguhr. Above the top of the banks due allowance must be given for expansion, and on the walls not provided with a door vertical slits should be incorporated, varying from $\frac{1}{8}$th to $\frac{1}{4}$ of an inch to the foot, according to the quality of the bricks. When the furnace is completely bricked, we would suggest that you cover the hearth with weighted bricks, to protect the bottom connection from warping and then thoroughly dry the side walls by suspending a fire bucket in the furnace overnight. This is essential, as steam coming from the side walls may later cause the dolomitic hearth to perish.

As no dimension is given of the height of the furnace, we can only suggest that you make the hearth as thick as possible. Having determined its depth, the figure found should be reduced by three inches and divided into five equal parts, which we will letter alphabetically, calling the uppermost layer A. The procedure will be as follows:—The false floor having been removed, the bottom connection must be thoroughly well cleaned and completely covered with a paste made from ground Acheson graphite electrode with a minimum of dehydrated tar to the depth of one inch. Following this a 2-in. layer of powdered amorphous electrode similarly prepared should be imposed.

All materials used in the preparation of the hearths and banks must be dried. Most electro-metallurgists insist that they should be hot when placed in the furnace for ramming. This we believe to be unnecessary, providing the materials have been recently dried, mixed with hot water-free tar in a sand mill, and rammed into position with red-hot rammers.

If all the materials are extremely hot, the job is liable to be inefficiently carried out, owing to its unpleasantness due to tar fumes.

Simultaneously with the preceding work, there should be made some forty iron or mild steel spikes $\frac{3}{8}$ in. round and 1 in. longer than four-fifths of the thickness of the hearth. These are to be driven in on completion of layer B, and will form two rings, one beneath the angle which the bank will form with the bottom, and the other 6 in. nearer the centre point of the furnace. The composition we propose is set out in Table I.

Table I.—*Proposed composition for a Small Electrically-conductive Furnace Hearth.*

Layer.	A.	B.	C.	D.	E.
Magnesite	20	20	15	10	—
Dolomite .. .	80	80	80	80	80
Clean Nails	—	—	5	7	5
Carbon	—	—	—	3	5

The above percentages are by volume.

The amount of tar to be used is a matter of a little experience, but in any case it should be kept at a minimum, as it must be borne in mind that the tar-oils resting on the bottom connection can insulate it for very long periods, and therefore a system of drainage must be incorporated. This is usually carried out by the drilling of a few holes through the bottom plate of the furnace, which can afterwards be filled in with fire-clay at once, in order that the combustion of the lower layers of carbon may be assured. We presume an adequate template is available for the formation of the banks, which are preferably made of the mixtures used for layers A and B, though tarred dolomite, if of the best quality, will serve equally well. Drying and burning-in is accomplished in the usual manner by arcing on to coke. Should difficulty be experienced in making the hearth conductive, it can usually be overcome by the imposition of a fire beneath the bottom connection.

THE USES OF METALLIC CADMIUM.—Mr. P. H. Brace, in a Paper presented before the Institute of Metals, summarised the more important uses of cadinium as follows:—1. As a reducing agent in the preparation of metals and alloys from their oxygen and halogen compounds. 2. As a reagent in the purification of the inert gases. 3. As a scavenger in non-ferrous metals and alloys. 4. As a scavenger, decarburiser and desulphuriser of ferrous alloys. 5. As a dehydrating agent, as in the treatment of oils and alcohols, for example. 6. As a means of fixing atmospheric nitrogen. 7. As a source of pure calcium carbide by direct reaction with pure carbon. 8. As a stiffening filling for hollow metal structural members. 9. As a constituent of a light aluminium alloy having useful properties. 10. As a hardening component in certain lead-base anti-friction alloys

Moulding Heavy Fly Wheels.

By E. Longden.

It is proposed in this article to describe the production of heavy fly-wheels, and, as an example, the one shown in Fig. 3, which weighs about 12 tons, will be taken.

In ordinary practice a full pattern is made, but with the method to be outlined only one-half pattern is needed to make two half-moulds, which, on assembling, make a full wheel. Such patterns are expensive to make and the cutting down of the pattern-making costs by one half should commend itself and is worthy of adoption.

The pattern and moulding box are constructed with a view to their use for varying types of wheels. The specification may demand, for example, a rope fly-wheel, and for this, the addition of a core print to the pattern around the outside of rim, allows for cores, which form the grooves, if too deep to machine throughout. Sometimes the width and depth of rim and boss are altered. The half-pattern is made in two pieces divided as shown in Fig. 3, one piece of the pattern is made a little more than half, the other

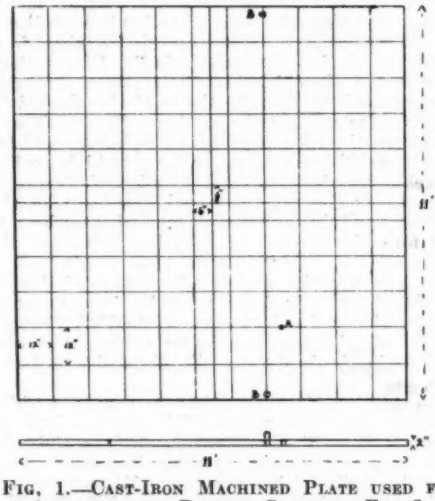

FIG. 1.—CAST-IRON MACHINED PLATE USED FOR ATTACHING THE PATTERN SHOWN IN FIG. 3.

half less by the amount in excess on the other half; this allows for machining when the fly-wheel is required in halves.

Fig. 1 shows a cast-iron machined-plate, 11 ft. square by 2 in. deep, levelled permanently in a suitable place on the foundry floor. The moulding plate is marked out accurately in the machine shop, and the lines machined on the plate are used to locate the dowels of pattern and moulding-box pins. AA, Fig. 1, are holes to receive the pattern dowels, BB are moulding-box pin holes tapped to hold short pins, standing 3 in. clear of the plate. In each case the holes run clear through the 2 in. plate, and so reducing any trouble that might arise from clogged holes. The half-pattern must be carefully dowelled on to the plate by the pattern-maker, and the pins in the plate and hole in the moulding box set by a competent man, as the final success depends upon the accuracy of such items. The two halves of the mould are alike, and when placed together should register truly and without any overlapping of joints. It is only necessary to dowel one piece of the pattern to the plate, the other piece being set against the one first placed. A dovetailed piece on rim ensures accuracy.

Fig. 3 shows the two pieces of the half-pattern as set on the moulding plate ready to receive moulding box.

When making a range of fly-wheel moulding-boxes, consideration must be given to possible variations in the original pattern. By the exercise of foresight the moulding box can be constructed to deal with such alterations, thus reducing the number and expense of a multiplicity of boxes. Fly-wheel moulding-boxes are subjected to much strain due to the heat radiation from the casting and the consequent expansion of the box, particularly on the outside, whilst the inside portion of the box is somewhat restricted when expanding, due to being on the inside of the rim. As the dissipation of the heat is not uniform, unequal expansions accrue, resulting, too often, in the almost complete destruction of the moulding-box. Trouble is also experienced with the pin holes, shown at A, Fig. 2, due to the change brought about, by the high temperature, in the condition of the cast-iron in various parts of the moulding box.

The life of the boxes is considerably lengthened by constructing as shown in Fig. 2. Each half box is made in six pieces. The outside ring, B, is in two pieces, struck with a strickle in loam or sand. When cooled the semi-circular rings will be found to have opened from 1 in. to 2 in. Contraction takes place in the direction of its length resulting in a casting which is not true.

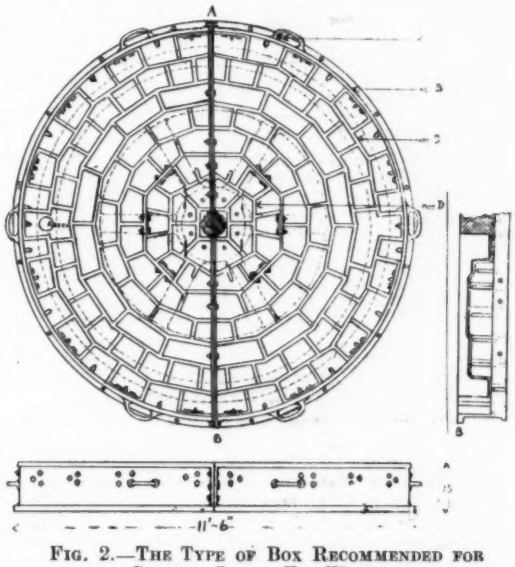

FIG. 2.—THE TYPE OF BOX RECOMMENDED FOR CASTING LARGE FLY-WHEELS.

To remedy this an eccentric or race spindle should be used when striking the mould. The strickle should be made to sweep the outside of ring, the inside being formed later by laying loose pieces of pattern against the outside already made. Short bars are also cast on the inside of the rings to help to hold in sand. Wrought-iron lifting-handles are cast on the outside of the ring also. The inside bars are made in four pieces, two making the centre D. and two the inner parts C. Several short bars only are needed to construct these inside portions of the box, one section of the mould is rammed up and the bars drawn out to form another portion of the mould until the whole of the mould is complete. The bars are staggered to minimise contraction and expansion strains. The sections B, C and D, are firmly bolted together as illustrated. The bolt holes are slotted to allow of alterations to the moulding box and ease in assembling. A box made thus, with loose bars, will allow of modification to suit various patterns, be free from contraction strains, and will allow of the box being unbolted after casting. Inside bars can be replaced by others to suit a serious change in design of wheel.

With the pattern set on the plate as shown at Fig. 3, the moulding box is placed over it, guided exactly into position by the pins at C.

The accessibility and ease with which the mould is made is obvious. Each half is rammed in a similar manner on the plate. By the old method the top is rammed on the bottom, which necessitates much labour for conveying materials to the greater height. Moulding is proceeded with in a general way. If good, strong refractory facing-sand is used, very few gaggers will be needed. The mould must be solidly rammed without pinching the sand between rammer and pattern. To allow turning

over of the box when rammed the pattern is held in the mould by bolts fastened in the usual way to the pattern and moulding box. A slight clearance is allowed between the two sections of the half-pattern, and with draft, no trouble is experienced in obtaining a good draw from the sand. No loosening of the pattern is allowed other than a steady rap with mallets as the crane takes the weight. It is necessary when finishing the mould to face-sprig the boss and arms immediately adjoining it for about 3 in., and also where the arms meet the web. The mould is dressed with a coating of best plumbago, terra-flake, and small proportion of core gum and claywater.

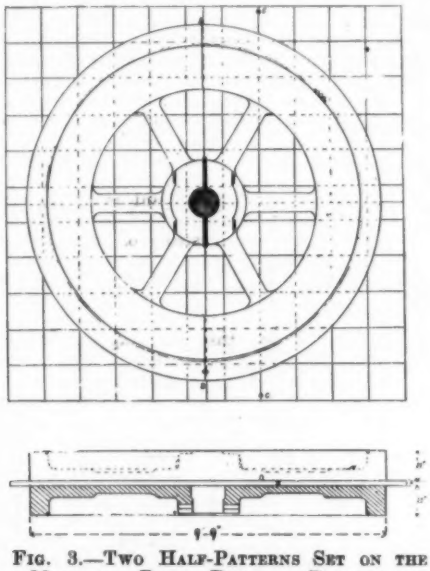

Fig. 3.—Two Half-Patterns Set on the Moulding Plate Ready to Receive the Moulding-Box.

With fly-wheels having split bosses, the writer considers that the boss is the most convenient position for running the casting. If the drop runners are made small, 1¼ in. dia., eight of them will run twelve tons quickly and cleanly, distributed as shown in Fig. 2. One 6 in. riser on the rim is sufficient on this size of wheel if due care is taken to feed with the rod and new metal until solidified.

In most cases where trouble arises due to insufficient drying, it occurs in the top side of the mould. It is wise, therefore to make tops of moulds first and stove before proceeding with the bottom side; this ensures a thorough drying of the top. The bottom stands the metal with much less drying.

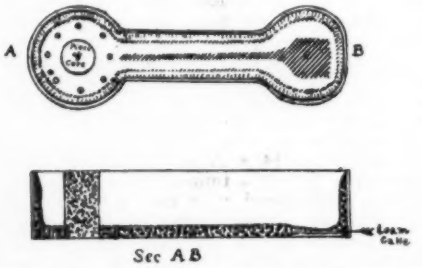

Fig. 4.—Plan and Section of the Runner-Box.

When closing the mould, loose, neat, short-fitting pins are used to locate top with bottom box, as a flat joint only necessitates the use of short pins. Splitting cores, etc., are divided at the joint, half in the top and half in the bottom. A runner box is made as shown in Fig. 4; it should be deep and narrow. It is desirable to have as little surface as possible on the bottom of runner made to avoid breakdown of the sand, as this sometimes happens towards the middle of the pouring operation. Wide open runner basins are a constant source of danger. A round piece of core should be placed in the centre of the ring of runners. The depth of runner box should allow sufficient head metal to admit of an overflow at the riser, at the same time allowing enough head in the riser to feed efficiently. The overflow is led down a sloping gulley to the foundry floor.

An hour after casting every bolt in the box, all of which are accessible from the outside, should be well loosened, freeing every part of the box, thereby ensuring the safety of the box from fracture.

The facing sand should be milled and made up of 60 per cent. red sand, 10 per cent. sharp sand, 20 per cent. black sand, 5 per cent. coal or coke dust, and 5 per cent. horse dung, whilst for the mould-dressing, 80 per cent. plumbago, 10 per cent. terra flake, 6 per cent. fire clay, and 4 per cent. core gum, mixed with sufficient water to make a thin cream, is used.

A good mixture for the metal for moulding boxes is 60 per cent. No. 3 Hematite and 40 per cent. selected scrap.

An analysis of metal suitable for heavy fly-wheels is Si. 1.5, S. 0.08, P. 0.4, Mn. 0.7 per cent.

Malleable Castings for Automobile Use.

Useful information in the preparation of malleable iron castings for use in mechanical engineering and particularly motor work is contained in a recent article in "Auto-Technik." The author, after briefly discussing the properties of malleable iron, proceeds to describe the methods adopted in Germany for making the castings. For small and thinner castings the cupola furnace is used and for larger and thicker castings or for very high quality material, reverberatory and open-hearth furnaces In Germany the reverberatory furnaces take the form of small drum-shaped furnaces heated by tar-oil. The advantages of the various types are discussed.

The raw material used is a burden consisting of low-phosphorus pig iron, wrought iron or steel scrap, with certain discard material added. Foreign brands of pig are now being replaced by the special pig obtained from the Kupferhütte Duisburg.

The raw cast iron must have a perfectly white fracture and must not exhibit segregations of graphite. The silicon content should be sufficiently high to prevent graphite segregation and to promote the malleablising process. Manganese and sulphur make the tempering process difficult. The percentage of sulphur, however, depends very largely on the smelting process adopted. The carbon content should obviously be kept low.

The chemical composition in general is closely related to the process of melting adopted. The table shows a good average composition.

Average Composition of Unheated Malleable Iron.

Furnace.	Per cent. Si.	C.	Mn.	P.	S.
Cupola ..	0.70	3.3	0.2	0.09	0.22
Crucib'e ..	0.70	2.9	0.2	0.09	0.12
Reverberatory	0.75	2.8	0.2	0.09	0.08
Open-hearth ..	0.75	2.7	0.2	0.09	0.07

The heating period depends on the thickness and chemical composition of the castings, being more rapid with a high silicon and low carbon and sulphur contents. The tempering material added to the cast-iron pots used for treating the castings is generally hematite or mill scale in the German method. After leaving the pots on treatment, the castings are treated in special drums to remove the ore, after which they are "rectified." The writer discusses at some length the precautions necessary in dealing with the initial castings to prevent cracking and breaking on treatment, and gives a few illustrations showing how these defects and blow-holes, piping, etc., may be avoided. In conclusion, some space is devoted to the question of the mechanical properties and microstructure of malleable iron castings.

Iron Ore in Ceylon.—The Ceylon Industries Commission appointed under the Empire development scheme is conducting a careful survey of the iron deposits in the island. Some samples of iron from the Kurimagala district analysed some time ago were found to contain 50 per cent. of iron. Ceylon has no coal, but hydro-electricity might be made to take its place if good quality of ore in fair quantities is discovered, or the ore might be exported to Bengal.

A Modern Brass Plant.*

By F. L. Prentiss.

Two new plant units recently have been placed in operation by the Detroit Copper & Brass Rolling Mills, Detroit, equipped according to the latest developments in processes and practices in the brass melting and manufacturing industry and arranged for economical production by the conservation of manual labour, use of handling equipment, and the direct passage of material in the process of manufacturing. A predominating feature is that electricity is used almost exclusively for the melting of brass. Pouring pits are virtually eliminated, thus economising labour. All mills and other manufacturing equipment are motor-driven.

The extensions include a melting shop and brass manufacturing plant occupying adjoining connected buildings with a brick wall between. The casting shop supplies metal for the entire works in the form of flat slabs, known as bars, for the brass department, and billets for rods, seamless tube and wire. Its daily capacity is 80 to 90 tons. The operations in the plant have shown that a much more uniform mixture is secured by the use of the electric furnaces and that the production costs have been reduced considerably as compared with the use of pit furnaces.

The brass manufacturing department is designed for large production of light, thin gauge sheets, about one-half of the product being in 30 gauge and lighter down to 0.001 in., and the remainder in heavier than 30 gauge. In widths the sheets are made up to 12 in.

The material has a direct passage from the casting shop through an alcove to the brass manufacturing department. After passing through breaking-down rolls, annealing furnaces, scalping machines, run-down rolls, other annealing furnaces and a second set of run-down rolls, the material goes through another annealing furnace at the end of the building, at right angles with the length of the building. Therefore, the brass or copper charged into the furnace in the first bay is delivered from the opposite end of the annealing furnace into the second or middle bay, where all the finishing operations are performed. Two of the other annealing furnaces are similarly transversely arranged for convenience in transferring the material from the finishing rolls to the adjoining bay for the operations that follow rolling.

The sheets pass back down the centre bay in the opposite direction from which the material was passed up the first bay, the various rolling operations being performed *en route*. Then they pass directly over to the third bay for the operations following rolling, provided they are in the heavier gauges. The lighter gauges are given the necessary passes for further reductions through additional rolls on the opposite side of the centre bay before going to the final finishing department.

Each bay is equipped with a 5-ton Shaw electric travelling crane, used for supplying the mills with metal. Trucks carry the metal from the rolls to the annealing furnaces. Similar cranes are provided in the casting shop for charging the furnaces, handling the bars and billets and for other service.

The casting shop is 199 ft. long and the brass manufacturing department 474 ft. long. Both are 183 ft. wide, of steel and reinforced concrete, with practically continuous glass sides set in Fenestra steel sash. The casting house has two monitors, the side walls being 32 ft. high and the top being 45 ft. from the floor. The monitor sashes are stationary, ventilation being provided through sixty-four 48-in. Swartwout ventilators in two rows, staggered. Continuous rolling steel doors are on each side of the building. Both buildings have wood block floors except in front of the furnaces. The roofs are of gypsum tile.

The casting shop extends over the Detroit River, the building site having been filled in for 150 ft. out to the harbour line, and a concrete dock extends along the water. It is the intention eventually to bring refined copper by boat from the head of the lakes direct to the plant. Two railroad tracks extend along the west side of the two buildings.

The brass manufacturing plant is of sawtooth construction, but differs in design from the usual building of this type. Instead of having equal column spacing in each direction, the distance between columns across the building is 60 ft. and the column spacing lengthwise is 20 ft. In place of the usual steel roof trusses, supported on the girders and columns, this building has sloping I-beam purlins, supported on lateral trusses and cantilevering over the trusses at the top, a distance of 2 ft. 4 in., to bring the sash out far enough from the truss to allow the ventilating sash in the sawtooth roof to swing in the centre instead of at the top, as in the usual arrangement. The sash swings 120 deg., affording much better ventilation than a top-hung sash.

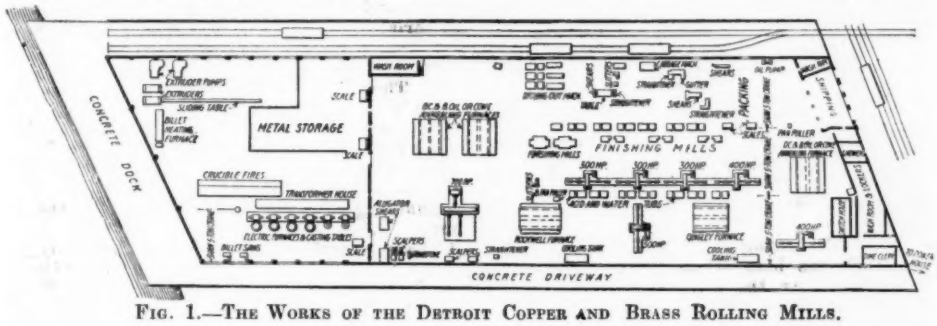

FIG. 1.—THE WORKS OF THE DETROIT COPPER AND BRASS ROLLING MILLS.

The casting shop is equipped with six 300 kw. melting furnaces of 2,000 lbs. capacity, and two additional furnaces will be installed. One spare furnace drum is provided. The furnaces are of the rocking type, built by the Detroit Electric Furnace Company. They are in a row in the east bay and stand on 3½-ft. pedestals. The furnaces, details of which are shown in Fig. 2, are fed from a charging floor that extends over the furnaces 2 ft. above the furnace tops and about 12 ft. above the floor of the casting shop. Above each furnace is a 14 × 22-in. hole in the charging floor, through which a funnel reaching down into the furnace is placed when charging.

The charge of refined copper, spelter and scrap, and sometimes a little lead, is made up in the stock room in a portion of the two adjoining bays back of the melting furnace. A standard size of charging box is used, holding 2,100 lbs., the usual charge. This is placed on an electric truck, which carries it to the furnace bay after being weighed. An electric travelling crane picks up the charging box and delivers it to the charging floor.

One of the interesting features of the casting shop is a specially-designed turntable in front of each furnace on which the flat metal moulds for casting brass sheet bars are carried. This turntable is approximately 10 ft. in diameter, and consists of a cast-iron base, a section of pipe in the centre forming the axis for revolving, and angle iron structural members which support the moulds. The moulds are of cast iron and consist of two parts hinged together, a stationary part being clamped to the frame of the turntable and the front part swinging on hinges. Before pouring, the two

* Extracted from the "Iron Age."

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sections of the moulds are clamped together at the top, bottom and centre by three bands and wedges, the wedges being driven between the bands and the front of the moulds, holding the two parts together firmly. Then a pouring box is placed over the top of the mould. The turntable revolves on ball bearings that support a sub-base 40 in. in diameter in which the turntable rests. The turntable is held in position by a cone cast to the sub-base into which the pipe axis of the turntable fits. At the top of this pipe is a hook for handling the turntable with the crane.

Turntables are provided in different heights to hold moulds of different sizes, and little time is required in changing the table, should it be desired to pour moulds of a different size. There is a mould capacity on the turntable for 2,500 lbs., but usually twenty moulds are used for flat metal, these being sufficient for pouring one heat. The metal is poured directly from the furnace spout into a mould and then the turntable is moved until the next mould comes in line with the pouring spout. The turn-table revolves so easily on the ball bearings that one man can turn it. Turntables of similar design are used for handling billet moulds, but as these are much larger, one turntable carries only three billet moulds. The billets used for making rods and wire are cast 6 in. in diameter in 72-in. lengths, weighing approximately 750 lbs. However, brass billets weighing as much as 5,000 lbs. have been cast in the plant. The billets are sawn into three 24-in. sections. A Newton cold saw cuts the billets and removes the gates.

In the centre bay are thirty-two coke-fired, pit type, crucible furnaces, consisting of four floors with eight furnaces to a floor. Adjoining these is a concrete pit for pouring the moulds. The pit furnaces are used only as spare equipment for melting small quantities or special heats. J/b cranes handle the crucibles while pouring.

At the lower end of the centre bay is a Marcy mill and three Wilfley tables for recovering brass and copper from the ashes of the pit furnaces and from the sweepings around the mills. These sweepings are dumped into a pit from which an elevator raises them to the mill. In this the material is rotated in a barrel containing steel balls and crushed, separating the metal and ash. A stream of water washes out the small pieces through openings in the barrel to an oscillating separating, or washing, table, over which water flows. The metal moves lengthwise over the table and is deposited in a trough, and the lighter matter, known as tailings, passes over one side of the table.

The scrap, or washings, from the table is passed through a magnetic separator and then sent back to the electric furnaces for re-melting. The fine material or tailings, separated in the washing process, is sold to smelters. The reclaiming equipment was put in particularly for use with the pit furnaces, but with the departure from the original plan which has resulted in the almost exclusive use of the electric instead of pit furnaces, it is expected that there will not be much need for the mill and washing equipment. Experiments are now being conducted on the recovery of copper from the scale by the electrolytic process, which will be continued if it is found profitable.

The extrusion process will be used in the manufacture of rods from billets and two extrusion presses are now being installed in the cast shop. These are 2,000-ton presses, built by the Southwark Foundry & Machine Company.

The brass manufacturing plant is equipped with twenty-four stands of rolls, located along the inner side of the east bay and on each side of the centre bay, those in the centre bay being finishing rolls. The first set is a tandem pair of 22-in. breaking-down rolls. The bar passes from the first set of rolls on to a guide and the roller pushes it along on the guide into the second set. Tandem rolls eliminate one trucking operation and the labour of two men is saved, as compared with the use of two separate single stands. Only four men are required to handle the bars through the tandem stands.

The bars, on entering the brass-rolling department from the casting shop through an alcove, go to two motor-driven alligator shears where the gates are cut off and additional metal is removed, should the ends of the bars not be solid metal, and

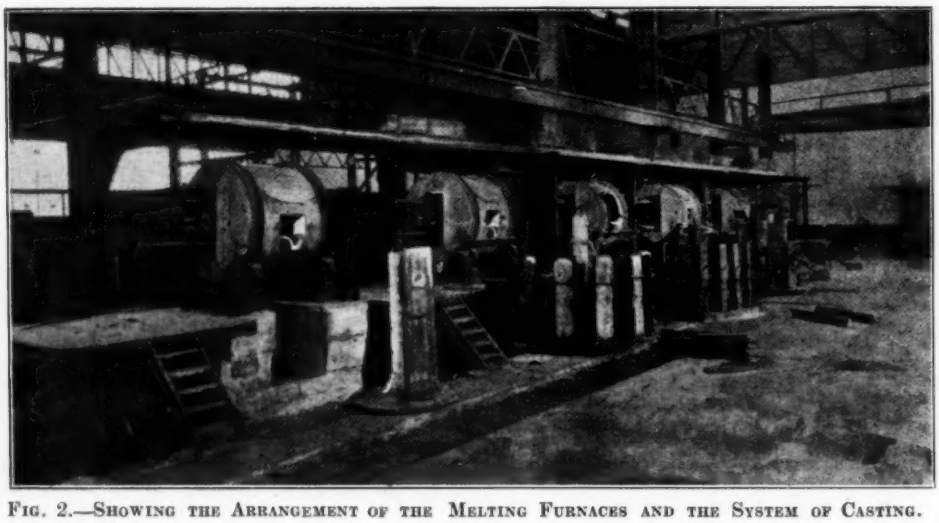

Fig. 2.—Showing the Arrangement of the Melting Furnaces and the System of Casting.

then go to the breaking-down rolls, each set reducing the thickness of the bars approximately 25 per cent.

After the two passes in the breaking-down rolls the bars are annealed in double-end annealing furnaces. There are ten of these furnaces set in pairs, of the same size and generally similar in construction. They are of the under-fired type with chambers 7 × 28 ft. The furnaces are oil-fired, but they are so arranged that coal or coke can be substituted. The metal is charged into the annealing furnaces on long steel plates, or pans, placed on trucks that bring the pans to a level with the furnace floor. The pans are coupled and are pulled through the furnace with a winch, one charge being drawn in while the other is drawn out. The furnaces are Quigley & Rockwell type, but some have been designed in the plant.

After the first annealing the bars go to the opposite side of the bay, where they are straightened on a five-roll straightening machine. Then the scale and rough surface are removed. Scalping machines, built by the Waterbury-Farrel Foundry & Machine Company, are used for the widest bars but for widths up to 10¼ in. a milling machine, built by the Torrington Company, is employed for scalping. This machine has a cutter 12 in. wide, similar to a milling cutter, and a capacity of milling both sides of 600 to 800 bars per day. After scalping, the bar is given another pass through each of the tandem break-down rolls, and on leaving the second set of rolls is coiled on a coiler attached to the mill stand.

All of the larger rolling units, after the breaking-down rolls, consist of two sets of rolls with a single drive. After the second pass through the

breaking-down rolls, the next rolling operation is through 20-in. run-out rolls, and from there to another pair of annealing furnaces. Much of the metal is pickled after annealing by placing the brass on a truck and putting the truck and its load in a large pickling tank with an overhead crane.

After the 20-in. run-out rolls, the bar passes through a set of 18-in. run-out rolls. There are two sets of 18-in. rolls, one a finishing set, having rolls 30-in. in width. The finishing rolls include six 16-in. rolls, arranged in pairs, and ten smaller sets, six with 9-in. rolls and four with 10-in. rolls, both 16-in. in width. A separate drive is provided for each of the smaller finishing rolls.

All of the rolls, except the breaking-down rolls and the first run-out set, are placed in a line parallel to the length of the building. Unless sheets are to be rolled in very light gauges the material, after passing through the larger finishing mills on the eastside of the centre bay, goes directly across to the west bay for the finishing operations that follow rolling. Some of the finishing rolls are so arranged that, if it is desired, the metal is given a pass through one set of rolls and back through the rolls of the adjoining mill that are running in the opposite direction. The mills were built by the Mesta Machine Company, Waterbury-Farrel Foundry & Machine Company, and the A. Garrison Foundry Company.

An interesting feature of the mill equipment is that the coilers are so designed that the motor that drives the coiler is attached to the bottom of the coiler table, and swings with the coiler to which it is directly geared, thus eliminating all belting. The motors for the coilers have push-button controls.

In the west bay are drying-out, shearing, slitting and straightening machines, and the packing and shipping department.

Electric current is received from a commercial station at 4,600 volts, and is stepped down to 440 volts for the rolling mills and 110 volts for the melting furnaces. For emergency purposes current is also supplied at 440 volts from the power station. For the melting furnaces the current is transformed at each furnace. A brick transformer house extends along the back of the furnaces.

Uniform artificial lighting is provided in the brass manufacturing department with 500-watt Mazda lamps furnishing an intensity of 5 or 6-ft. candles at the working plane.

Most of the pickling tanks are between the columns and convenient to the adjoining finishing roll, a tank driving each set of rolls. Each of these tanks is served by an electric hoist that has as its runway the lower flange of the travelling crane runway, making a convenient and economical arrangement. Oil is stored in a 100,000-gallon concrete oil-proof tank situated in the basement, from which it is pumped underground to the furnaces.

Well-equipped physical mechanical laboratories are on the second floor. The physical testing laboratory has equipment for testing temper hardness and tensile strength.

The new casting shop and brass manufacturing plants were designed by Smith, Hinchman & Grylls, of Detroit.

CLASSIFICATION OF LEAD PRODUCTION.—Sub-committee I. of the American Society for Testing Materials' Committee on non-ferrous metals and alloys now specify for both low-bismuth and high-bismuth corroding lead, as follows:

Element.	Low-Bismuth Corroding Lead Per cent. Not over	High-Bismuth Corroding Lead Per cent Not over.
Bismuth	0.0050	0.0500
Silver	0.0015	0.0010
Copper	0.0015	0.0010
Copper and silver together ..	0.0025	0.0015
Arsenic	0.0015	0.0015
Antimony and tin together	0.0095	0.0060
Zinc	0.0015	0.0015
Iron	0.0020	0.0020
Lead (by difference) ..	99.9780	99.9375

The "Breakir" Sand-Mixing Machine.

The outstanding feature of the "Breakir" sand-mixer, which is manufactured and marketed by Messrs. W. Brealey & Company, Limited, of Russell Street, Sheffield, is the incorporation of a patented adjustable reel, by means of which the fineness of the sand or other material which has to be ground can be regulated in a few minutes without any dismantling, nor is it necessary to carry spare reels in stock. The changing of reels is liable to disturb the bearings. The mixer which is illustrated in Fig. 1, is of robust construction. The casing enclosing the revolving cages is cut from steel plates securely fixed to the main frame casting, and held together by steel stays, giving perfect rigidity and safety from accidents, which not infrequently occur where

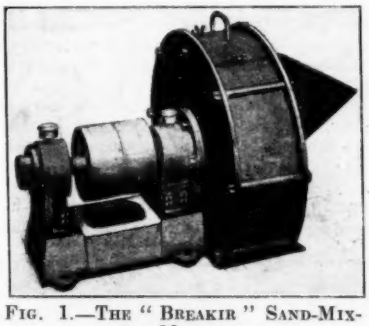

FIG. 1.—THE "BREAKIR" SAND-MIXING MACHINE.

the casing is of cast iron. The machine is fitted throughout with roller bearings, so arranged that they automatically take up all end thrust, thus giving a low power-consumption and requiring little attention, except for periodical adjustment and lubrication.

The application of the adjustable reel is shown in Fig. 2, where the self-contained reel "A" is adjustable to the extent of half the pitch (between the centres of any two spindles) round the fixed reel "B." This is obtained by slacking-off the nuts at the back of plate "C," adjusting the reel to the desired position, and locking firmly in position.

As the entire machining and fitting is carried out by a system of jigs and gauges, the interchangeability of any parts requiring replacement is assured. All machines are fitted with fast and loose pulleys, and effective means are taken to exclude sand and grit from the bearings, the

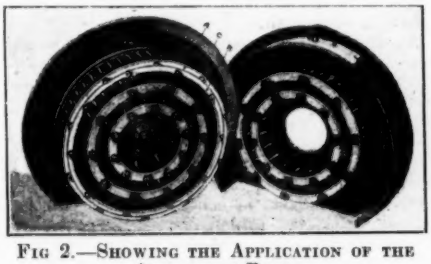

FIG 2.—SHOWING THE APPLICATION OF THE ADJUSTABLE REEL.

special method of lubrication also being an additional feature towards this end. The machines can be fed by unskilled labour.

The machines will deal with any class of friable material which requires breaking or mixing, or combined, such as lime, slag, coal, coke, sand, cork, shale, chalk, starch, shells, pitch, clays, chemicals, manures, asphalts, gypsum, etc.

Whilst the 20-in. size of machine will deal with 1 ton per hour, a 28-in. double type will turn out 4 tons per hour, the former taking 2 ft. 3 in. by 2 ft. 6 in. of floor space and 3 h.p., and the latter 4 ft. 6 in. by 4 ft. and 8 h.p. This double size is designed to deal with harder material. It is operated by having two belts running in the opposite direction, but as these are both on the same side of the machine it leaves the feed side available for the operator to feed the material into the hopper.

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Protective Coatings for Metals.*

By Leon Guillet

The methods employed for the protection of metals divide themselves into three categories:—

(1) Where the coating is obtained by a reaction with the metal itself.

(2) Where the coating is constituted by means of another metal, which can alloy with the base metal.

(3) Where the coating is made by a non-metallic material such as a paint lacquer, etc.

Methods Utilising Reactions with Base Metal.

These methods are well known, and consist of the formation of coatings of sulphides, oxides, etc., by diverse means. In the Bower-Barff method, the material to be treated is heated to 900 deg. C. and submitted to the action of steam for 20 minutes and then for the same period to the action of town gas. It is said that material so treated has a greeny-black colour and is distinctly capable of resisting the action of acid vapours and sea water. Furthermore, this method has been improved upon by Gesner. After the normal treatment outlined above, the objects to be coated are held at 900 deg. C. and steam, superheated to redness, is passed over their surfaces for half an hour. The treatment is intermittent, and is carried out in an enclosed chamber. Finally, hydrocarbon vapours are introduced for a period of 15 minutes. If such a coating is examined it will be found to contain carbon and more than 2 per cent. of hydrogen. The results are more satisfactory and regular than those given by the Bower-Barff process. Unfortunately, the cost of these two processes is very high.

Fig. 1.—Box for Case Hardening, Half of which has been Calorised and Welded to the Non-Calorised Portion, and the Whole Submitted to Test.

Another process coming under this caption is now known, especially in the United States, as "Coslettising." After cleansing by the wet method, or preferably with a sand-blast, the objects are plunged in a boiling saturated solution of phosphoric acid containing zinc or iron clippings, and left there, according to the result desired, from thirty minutes to three hours. This method is said to be in general use for coating typewriter parts. It might serve some useful purpose to recall the method of Sestini and Rondelli de Bergame, which consists in cleaning and oxidising iron objects, utilising for this purpose "sodium ferrite," specially prepared.

Methods of Coating by Means of a Different Metal.

Galvanising, both hot and electrolitic, are too well known to warrant description. It might be useful to recall that the allied process of Sherardising consists of placing the objects to be coated in intimate contact with powdered zinc. The receptacle is heated to 300-350 deg. C. and rotated to maintain contact, and the zinc is evenly cemented on the surface of the objects. It is customary to add to the powdered zinc a little naphthaline, in order that a reducing atmosphere may be created and more brilliant coating given. Tin-plating, leading, copper plating, bronzing, gilding, and silver plating all enter into this category of protective coatings, but little new work has recently been published.

The Schoop process consists in spraying liquid metal on the objects to be covered. To accomplish this, wire of metal to be melted is passed through a "pistol," where it is melted, either by a burner or by contact with a similar wire, the two wires receiving a suitable electric current. The metal, thus melted, is violently projected by compressed gas against the object. This process has reached important dimensions during the last few years.

Processes Incorporating Non-Metallic Materials.

Whilst it is impossible to deal completely with this section which includes enamelling, painting, etc., the importance of lacquering should not be lost sight of. The metal is covered by brushing over or in the French method, powdering over with latex. Drying is conducted in damp air at 40 to 50 deg. C., and lasts about 48 hours. The hardness and resistivity of this coating very largely depends upon the drying. Metal so coated resists heat, acids, and strong alkaline solutions. This résumé would not be complete without mentioning Bakelite, which gives interesting results from the ornamental point of view.

The Principles of "Calorising."

This process consists essentially in coating metallic objects with aluminium. The parts to be protected are heated to about 850 deg. C. in a rotating box-like furnace containing grains of aluminium to which have been added alumina and ammonium chloride. It should be pointed out that the temperature reached is well above the melting point of aluminium, and therefore is not comparable with sherardising.

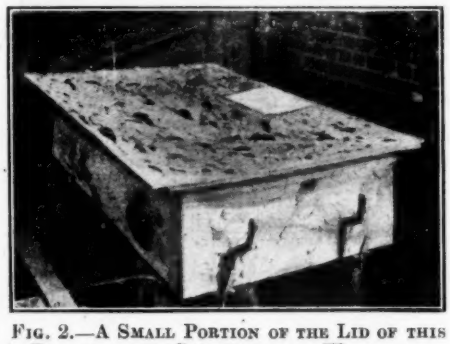

Fig. 2.—A Small Portion of the Lid of this Box has been Calorised and Welded into Position, and the Whole Submitted to Test, with the Result as Shown.

Many patents are in existence on this subject, and these are supplemented by secret processes, which probably seriously modify the published *modus operandi*.

Of American patents numbered 1,091,057 (March 22, 1913) and 1,115,974 (October 4, 1911), taken out in the names of Gilson and Van Aller respectively, the first one describes a method designed to prevent the oxidising of metals, and consists in heating such metals in a reducing atmosphere in contact with a mixture of powdered pure aluminium, alumina and a small percentage of a chloride, and, further, treats of the application of the process to iron, copper and other metals, and states that the metals are to be heated to temperatures ranging from 600 to 900 deg. C., depending on the material to be treated in contact with the mixture described.

The second patent, that of Van Aller, also utilises the mixture outlined above and claims a new metal, having on its surface a deposit consisting of an alloy of aluminium and the metal, this alloy being inoxidisable at high temperatures. Certain other patents, which apparently contain little new matter, are also in existence, but some quite recent patents, of which at least two are not yet published, are much more interesting and instructive.

In France, Patent No. 505,176, dated April 30, 1920, and granted to the Compagnie Thomson-Houston, which is not very clear, draws attention to the necessity of "diffusing aluminium

* Translated from "Revue de Métallurgie."

across the object" and to accomplish this, if it is not possible to add this metal directly to the alloy at the moment of its production, it should be heated for several hours at 1,000 deg. C. in the presence of the mixture. A further unpublished French patent exists.

The Process.

Apparently calorising has been used in the United States by the General Electric Company, since 1911, in connection with electrical apparatus, destined to withstand high temperatures. In practice, as far as can be gathered, heating is carried out at about 800 deg. C., the time factor being very valuable. The calorising powder is of the following composition:—Grain aluminium, 49 per cent.; alumina 49 per cent. and ammonium chloride 2 per cent. As stated, a rotating furnace is used, which gives an intimate contact, which allows of the formation of a true aluminium alloy, beneath a coating which scarcely is thicker than a few hundredths of an inch. It has generally been understood that the protection is due to a layer of nascent aluminium, which is produced during the heating, and is capable of withstanding any later attack on the parts so protected. If for any reason the aluminium coating blisters, a new skin is formed with the impoverishment of the alloy and the object is once more immune from oxidation.

Results Obtained.

Calorised material offers a remarkable resistance to gas attack even at high temperatures.

FIG. 3.—TWO FORGED IRON TUBE ENDS, OF WHICH THE LONGER ONE HAS BEEN CALORISED. BOTH WERE TESTED AT 980 DEG. C. FOR THE SAME PERIOD.

The method is applicable to siderurgical products, steel and cast iron, particularly white cast iron (no details of its application to special steels are available), copper and its alloys, notably bronzes and nickel. Generally speaking, worked material, *id est*, forged, rolled, pressed or drawn, calorised better than castings.

Freshly calorised material is rough, but it can be polished, the coating being quite durable. In a general manner, it can be said that material calorised at temperatures ranging between 700 and 800 deg. C. is from 5 to 20 times harder than the base metal, but for higher temperatures the hardness is lowered to twice or four times that of the untreated material.

Commercial Application.

The chief applications of this process are as regards steel and cast-iron articles: condenser tubes, furnace or other parts having to withstand high temperatures such as cementation boxes, parts of distillation apparati, engine parts (especially exhaust pipes), Diesel engine pistons, burners, grates, muffle, moulds for liquid glass and the like, protective tubes for pyrometers. Copper and copper alloys which can usefully be calorised are:—condenser tubes (this is an important application, as many tubes, though annually replaced, are often corroded after six weeks, but after calorising last eight years) and contacts. Special interest attaches to the calorising of wires and strips used in electric heating as their life is often doubled.

It should be remarked that all machining should be finished before commencing to calorise. Fillets should be trued-up after processing. If the article calorised has to be bent, the operation should be conducted at 800 to 850 deg. C.

The Cost of Calorising.

Though the cost is said to be low, no substantiating data is forthcoming. Certainly the operation should be less expensive than the preparation of the new inoxidisable alloys, such as nicrome, and the time has arrived when, if the process is to become common and attain such a size as to be of real interest to industry, the cost should be known.

Doubtless, the treatment being a surface one, the cost will be lower, the smaller and the more regular the size and the shape of the article is.

One of the most important factors in the cost of calorising is the powder employed, but fortunately this powder can be re-employed after grinding and sieving.

Properties of Calorised Materials.

Arthur Farr, writing in the "Iron Age," gives some tests on coated steel tubes and his results are given in Table I.

TABLE I.—*The Mechanical Properties of Calorised Steel Tubes.*

Test No.	Max. stress.	Elastic limit.	Elongation.	Red. of area.
	Tons per sq. in.	Tons per sq. in.	Per cent.	Per cent.
1	20.9	13.3	—	51.6
2	20.0	12.7	30.5	42.9
3	21.8	11.7	12.0	46.6
4	20.3	12.0	40.5	40.3
5	20.3	10.8	38.2	50.2
6	24.1*	10.8	46.0	60.0

* This figure is given in other sources as 17.5.—Editor, F.T.J.

The elongations show several anomalies. The author has made several tests on one of these

FIG. 4.—TWO THICK HOLLOW TUBES, OF WHICH THE TOP ONE HAS BEEN CALORISED, AND BOTH SUBMITTED TO A SULPHURIC ACID TEST.

tubes, with negative results. The Brinell test shatters the surface, even though carefully polished to eliminate all roughness. Reliable results can only be obtained by filing fairly deeply, but naturally such results only have reference to the dead mild steel beneath. Doubtlessly, the sclerometer gives the better results, but in any case, there can be shown the existence of a layer which possesses great hardness associated with fragility.

Micro- and macro-graphic examinations have yielded some interesting information. Macrographically, an oxidising attacking reagent shows up two zones; the one much more easily attacked is the portion non-calorised. The second zone is found to be at the side of the surface crust. Micrographically, a 4 per cent. nitric acid solution attack for two minutes, followed by an immersion in a ferric chloride or alcohol solution fo 10 seconds reveals three zones, the first of which presents the normal constituents of mild steel, the pearlite showing in small quantities; the second forms a straight band possibly formed of an iron-aluminium solid solution; the third, which is apparently very hard and fragile, is some iron-aluminium compound, probably Fe Al (transition point of the diagram). As regards the outer crust, which should be composed of aluminium, it is so fragile that it falls to pieces on polishing.

At the same time it seems possible, that the band intermediate between the coating and the hard portion containing the aluminium may be

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due to a foreign body, to which the exhibited patents make no reference.

Finally, calorising brings about important modifications in the electrical resistance.

Table II. shows the results obtained from calorised steel strip.

Table II.—*Showing the Influence of Calorising on the Electrical Resistance of Steel Strip.*

	Ordinary steel.	Calorised Lightly.	Calorised Deeply.
Electrical resistance in ohms per kilometre ..	0.566	1.470	4.58
Percentage increase in resistance per deg. Cent.	0.560	0.172	0.015

The Theory of Calorising.

Summarised, calorising is based upon the penetration of aluminium into various metals, forming an alloy with them of a more or less important thickness. It produces a coating of aluminium, which is specially protective and hard. The phenomenon is dual, inasmuch as it forms an alloy and

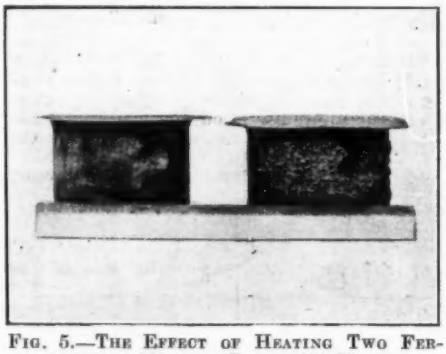

Fig. 5.—The Effect of Heating Two Ferrules at 800 deg. C. for 100 Hours.

an aluminium crust. The formation of an alloy, especially at the temperatures used, causes no surprise, for on reference to the equilibrium diagrams of the principal metals used—iron, copper, nickel, with aluminium, it will be seen that they show solid solutions on the side of the metal other than aluminium. These solutions have a maximum concentration of aluminium; 8 per cent. with copper, 12 with nickel and 33 with

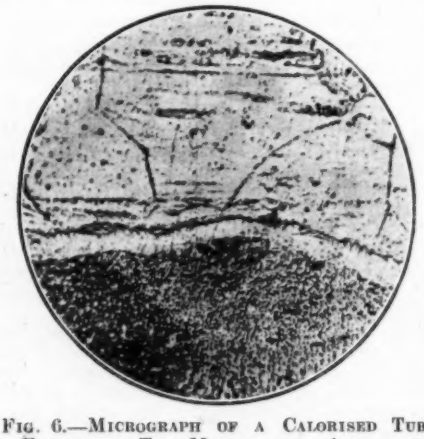

Fig. 6.—Micrograph of a Calorised Tube Etched for Two Minutes in a 4 per cent. Alcoholic Solution of Nitric Acid, followed by an Immersion in an Acid Ferric Chloride Solution for 15 Secs.

iron. It has also been established that these solid solutions exist in the ternary alloys Cu-Zn-Al and Cu-Sn-Al.

With regard to iron, the action of aluminium, even at low temperatures, has long ago been established. M. Le Chatelier has exhibited samples of iron in which large crystals were noticeable, which had been obtained by heating iron in contact with aluminium. In 1914, the author presented to the Société d'Encouragement pour l'Industrie Nationale, the results of experiments, with micrographs, he had made on this subject, using 450 deg. as the operating temperature.

There is thus no novelty in the fact of the copper, iron or nickel alloy with aluminium. The formation of the alloy is logical, and it clearly follows known researches and general theory. But the phenomenon was never regarded as an industrial one, and it was certainly not thought of as a protective coating.

An important point is the use of aluminium grains heated well above its melting point. This state of division retards melting and assures contact. Further the grain aluminium is mixed with alumina. It is thought that the alumina plays an interesting rôle, by preventing the coagulation of the aluminium by splitting up the mass and facilitating regrinding after use. It seems quite feasible that the alumina could be replaced by other materials. Ammonium chloride is present as a scavenger.

As to the formation of the aluminium crust, which was undoubtedly present in the samples examined, but it is very feeble and it is difficult to account for, especially in the case of copper. The author, however, has not examined calorised objects of this metal. Perhaps it can be associated with a secret trick of the trade. Be that as it may, it is quite certain that calorising presents a very real interest, and it is to be hoped that serious theoretical and industrial researches will be instituted in France.

It seems curious to state that aluminium can have a real future as a protective coating, and that its oxidising properties, which have often been reproached, would be the first cause of this interesting application. However, the protection appears to be due to the formation of an alloy and not to a thin and fragile crust of aluminium.

The Iron and Steel Institute.

The following is the list of papers which it is expected will be submitted to the autumn meeting of the Iron and Steel Institute in Paris on September 5 and 6:—(1) "Damascene Steel," by N. T. Belaiew; (2) "An Experimental Investigation of the Mechanical Properties of Steels at High Temperatures," by E. L. Dupuy; (3) "The Situation of the French Metallurgical Industry in the North and in the East of France: Its Destruction and Reconstruction," by L. Guillet; (4) "Does the Critical Point Depend on the Strength of the Magnetising Field?" by K. Honda; (5) "On Constituents Found in Tungsten and Molybdenum Steels," by A. Portevin; (6) "A Contribution to the Study of Coalescence," by A. Portevin and V. Bernard; (7) "On the Characteristic Curves of the Heat Treatment of Steels," by A. Portevin and P. Chevenard; (8) Iron Ore Deposits of Eastern and Western France, by P. Nicou; (9) "An Investigation of Various Forging Operations carried out under Hydraulic Presses" (Part II), by E. Schneider; (10) "Manufacture of Shells in Canada during the War, 1914-1918," by Capt. H. W. B. Swabey and R. Genders.

Members and Associates who desire to have advance copies of papers sent to them should make early application for them. They are earnestly requested to ask only for papers in which they are particularly interested, and bring their copies with them to the meeting.

New Bridge for Tokyo.

A project for the construction of an iron bridge across the Sumida River in Tokyo is reported in the Japanese Press, which states that the bridge which will start from Manseibashi will turn toward the left and run over the Kanda River, forming a canopy for the river to the Sumida River near the present Ryogoku bridge and across the river to the Hojo side of it. The elevation will be 40 ft., as it will run over the Kanda-Uyeno line, 20 ft. high. The work, it is stated, will be commenced in the fiscal year 1925-6 or 1926-7.

The Commercial Counsellor to His Majesty's Embassy at Tokyo (Mr. E. F. Crowe, C.M.G.) understands that the Imperial Railway Authorities at Tokyo have not as yet drawn up specifications for the bridge.

The Suggested Revival of Steel Syndicates in Germany.

Even in booming times some of the large works in Germany found that the regulations of the syndicates to which they belonged hampered their development and prevented them from taking full advantage of the conditions prevailing in international markets. On the other hand, in times of trade depression the syndicate idea always gained a greater measure of consideration, and this appears to be the case at the present time when the only syndicate in existence, nominally at all events, is the Pig-Iron Syndicate. As was recently mentioned in this journal, a proposal has been made to constitute a rail syndicate for the export trade, and now the problem of creating a tube syndicate has been brought forward, and steps have been taken to see whether an understanding can be reached as to the tonnage allotments in such a combination.

It is well in this connection to compare the situation in the past with that which exists to-day. The Steel Syndicate was formed in 1904, and starting from heavy products it aimed at the gradual combination of all kinds of manufactures in syndicates, so as to establish a grand organisation for the whole of the iron and steel industry. But conditions proved to be stronger than the advocates of the general scheme. When the Steel Syndicate—which is said to have ultimately degenerated into a bureaucratic establishment of the worst official pattern—became unable to accept delivery for the sale of all the tonnage allotments of the members, the hunt for further allotments began by the large works taking over small and medium-sized works in order to secure the tonnage participations of the latter. In this way the conditions for syndicates became displaced in so far as the development of the large works progressed, and the extension of the syndicates failed in consequence of the displacement in the groups of interests. It was only possible to prolong the Steel Syndicate itself by means of a provisional arrangement at the eleventh hour before the expiration of the agreement. With the conclusion of peace, however, the large Lorraine works and the connection with the friendly Luxemburg group of works were lost. What remained were the works in Rhenish-Westphalia, several works distributed over Germany of subordinate importance for the Syndicate, and a moderate share in the production of the Upper Silesian works. At first these appeared insufficient to form the basis for the creation of a new syndicate. A method might have been found for reviving the syndicate idea which would have been materially different from that which formerly prevailed, but in the meantime the Government and the advocates of Socialisation intervened, and that result was the formation of the Federation of the Steel Industry (Eisenwirtschaftsbund), which was a complete failure, and now, after one year of unfruitful activity, has been entirely side-tracked.

If now the syndicate idea is again closely occupying the attention of the works, it is necessary to recall the previously mentioned absorption of small and medium-sized works. Experience has taught that the larger the number of works in deliberation and the larger the number of special wishes to be satisfied, the greater is the difficulty of bringing a syndicate into existence. During the past year and a half, however, most of the works of lesser importance whose opposition frequently frustrated the syndicate idea, have been incorporated in the sphere of the large groups, so that only a comparatively few works now come into consideration in syndicate questions. It might perhaps be concluded from this circumstance that such deliberations would take a more peaceful course than formerly and speedily lead to an arrangement. But as compared with former times the conditions have changed in so far that powerful groups of merchants have obtained a great influence in the works. As it is frequently difficult to bring the interests of the works into harmony with those of the merchants, the resulting difficulties are substantially greater than formerly. Nevertheless, the hope has not been abandoned that the syndicate object, which affords the possibility of cultivating international relations, will be achieved within a reasonable period.

Book Review.

ENGINEERING STEELS, by Leslie Aitcheson, D. Met., B.Sc.—Published by Messrs. Macdonald & Evans, 29, Essex Street, London, W.C. 2. Price 25s. net.

Prof. W. C. Unwin, F.R.S., who has written a foreword to the book, states "the book may be commended to all engineers as throwing a flood of information on the varieties of steel now obtainable, the treatment to which they should be subjected, and the origin of the defects to which they are liable." That sentence adequately sums the *raison d'être* of the book, which in this respect fills very largely the gap between the metallurgist and the mechanical and civil branches of engineering. It must be remembered, however, that the author is primarily a metallurgist, and the views he puts forward for the instruction of the engineer are interesting, and are usually backed by his own experiments.

Though the value of vanadium as an alloying element as distinct from a scavenging material in steel metallurgy has often been discussed, Dr. Aitcheson now settles the question by publishing on pages 190 and 192, curves of the mechanical properties of a straight chromium and a chrome-vanadium steel, which show that equally good properties can be obtained by the former as by the latter. As to the use of vanadium in high-speed steels, Dr. Aitcheson summarises its benefit by pointing out "the presence of vanadium makes no difference to the fundamental mechanical properties of the steel, but it is stated by manufacturers of the steels to which it is added, to produce better results, in so far as the cutting powers and durability of the steel are concerned."

This statement seems to contradict (if the durability of a cutting edge can be regarded as a fundamental mechanical property) the time-honoured assertion that the addition of 1.0 per cent. of vanadium improves the value of a high-class high-speed steel five times. It would have been interesting if Dr. Aitcheson had put forward some proof, as he has done in the case of chrome-vanadium steel.

By the aid of the solution theory, Dr. Aitcheson has managed to give a succinct account of the influence of heat-treatment of various steels, without mentioning the existence of martensite, austenite, hardenite or any allotropic modifications of iron. He is to be congratulated on this, as most theoretical metallurgists could not have let the opportunity pass by without enlarging on their pet theory, and so detracting from the work from the engineers' point of view

The arrangement of the book has been to summarise steel-melting processes, to devote long chapters to the casting and working and heat-treatment of steel and then to deal exhaustively with the mechanical testing and properties of carbon and alloy steels.

A novel classification of alloy steels is adopted, and this most suitably. In place of chemical composition, maximum stress is taken as a base and submits to five sub-divisions.

Foundrymen anxious to ascertain what they are up against, by way of competition from alloy-steel forgings, will do well to study this book closely, as much is analogous to steel castings, as is shown by Dr. Giolitti's researches.

British Association for the Advancement of Science.—We have received from the Assistant Secretary, Burlington House, London, W.1, a copy of the preliminary programme and invitation circular to the coming annual meeting of the Association in Edinburgh on September 7 to 14. On September 9 the first evening discourse will be delivered by Professor C. E. Inglis, on "A Comparison of the Forth and Quebec Bridges, showing the Evolution of Cantilever Bridge Construction during the past Thirty Years." The sectional addresses include one by Mr. W. L. Hichens, President of Section F, on "The Principles by which Wages are Determined." Among the joint sectional discussions there will be one on "The Proposed Mid-Scotland Canal."

A RECEIVING order has been issued against Gilbert Saunders, trading as Robert Saunders, Bay-ho, Pattingham, and Doctors Piece, Willenhall, lock manufacturer and brass founder.

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Trade Talk.

WORK was restarted in a part of Messrs. Guest, Keen & Nettlefolds' works, Rogerstone, last week, after several months' idleness.

THE new rolling mill of the Tinsley Rolling Mills Company, Limited, is expected to be running in the course of two or three months.

MESSRS. SMITH & MCLEAN, LTD., have moved their Gartcosh and Mavisbank Offices to 195, West George Street, Glasgow.

MESSRS. ROBERT MURDOCH & COMPANY, iron and steel merchants, 23, Robertson Street, Glasgow, announce that their London office address is now 98, Cheapside, E.C.2.

THE No. 1 furnace at Cleator Moor has been blown in. It is reported that preparations have already commenced with a view to the restarting of some of the furnaces in the Workington district.

MESSRS. CORY & BLUNDELL, Cardiff, have purchased a Swedish built steamer, "Mercia," 1,100 tons deadweight, engined at the Tyne, and launched three weeks ago, at a cost of £50,000, for £14,000.

IT has been agreed that 6s. per week reduction shall operate for railway shopmen from August 15, when the second of the two cuts of 3s. came into force for engineers under the agreement with the Engineering Federation.

IN a written reply to Mr. Mills, Mr. Baldwin says that 1,000,000 tons of Swedish iron ore were purchased on the Government account in 1917. Of this only 165,000 tons remains at Narvik, and a portion of this has been sold.

TWO of the foundries of the Stanton Coal and Iron Company, Limited, Nottingham, have been started, to be followed shortly by two of the blast furnaces. These will provide work for 600 men who have been idle for a long time.

WELSH tinplaters are approaching the tinplate manufacturers with a view to their considering the situation created by the continual decline of the sliding scale. From the 9th inst. the wages of Welsh tinplaters are only 81½ per cent. above pre-war.

IT has now been decided to restart the Devonshire works of the Staveley Coal and Iron Company, Limited, which have been idle since the settlement of the coal dispute because production of pig-iron and coke was unprofitable.

ON the 3rd inst. the Turbine Furnace Company, Limited, received an order from the Garswood Collieries, Limited, of Bryn, near Wigan, to supply fifteen sets of turbine furnaces for as many Lancashire boilers, the first furnace having proved satisfactory.

IT is reported that there were 8,000 fewer unemployed registered in Sheffield last week, which speaks volumes for the steel and engineering trades, the major employers. Of the city's half million inhabitants there are still 34,000 wholly unemployed and 15,000 on short time.

A DISPUTE which has lasted some months, and has resulted in about a thousand hands being out of work, terminated last week by the re-opening of the Sterling Telephone and Electric Company's works at Dagenham, an agreement having been reached between the employers and employés.

THE SHIP CONSTRUCTORS' AND SHIPWRIGHTS' ASSOCIATION have decided by a large majority to withdraw from the Amalgamated Union of Shipbuilding, Engineering, and Constructional Workers. The other two unions in the amalgamation are the Boilermakers' Society and the Associated Blacksmiths. The amalgamation dates from 1919.

SEVERAL of the Cleveland ironstone mines which have been idle since last March re-opened August 8, and others are to re-start at an early date, the miners having assented to a further wage reduction, the third which they have suffered this year. Under the new agreement they are guaranteed a minimum of 8s. per day.

MESSRS. HARLAND & WOLFF have commenced the construction, in their new yard at Belfast, of a 32,000-ton passenger vessel for the Holland-America Line. This will be the largest ship begun since pre-war days. The firm have only launched two vessels this year, the motor-ship "Somersetshire," and the British Petroleum Company's tanker "Inverarie."

THE ENGINEERS' CLUB, the membership of which already exceeds 2,200, has acquired premises in Coventry Street and Whitcomb Street. The club is intended for the British engineering and allied profession. Mr. E. Manville, M.P., is the president, and Mr. E. L. Hill the honorary secretary. The club will be opened on Thursday, September 1.

MESSRS. DEAN & WOOD, who have been London representatives for the Hoop and Strip Department of Messrs. Richard Hill & Company, Limited, of Middlesbrough, for the past ten years, have given up the agency, and Messrs. Richard Hill & Company, Limited, have appointed as their London agent, Mr. Frank Powell, 118, Cannon Street, E.C.4

A SCHEME designed to give Manchester engineering students practical experience in the City Engineer's department was considered by the Town Hall Committee last week. It is proposed that two or three suitably qualified men should be taken on for a two years' course, during which they would pass through the drawing office and take part in practical engineering work.

THE workmen employed in the three establishments of the North British Locomotive Company are working four days per week. For a considerable time the employés have been on short time of five days a week, no work being done on Saturdays, but until further notice Mondays will now also be idle days. About 10,000 are employed at the three branch shops of the company.

THE working hours of the Royal Dockyards, which were reduced from 47 hours to 40 per week in February last to enable temporary work to be given to the unemployed were increased to 42 hours per week from last Monday. The yards will continue to be closed on Saturday, and the extra two hours will be worked by half-an-hour per day on four days of the week.

MESSRS. DANIEL DONCASTER & SONS, of Sheffield, one of the partners in the United Steel Companies, have built and presented to their employés a guest house at Froggatt, Derbyshire. Control is to be vested in a committee of three workmen and two members of the management of the company. A charge will be made to cover the cost of upkeep and provision of week-end accommodation for which the guest house is primarily intended.

ASKED by Sir J. Norton-Griffiths whether the Disposal Board are quoting £1,200 to £1,300 for Baldwin's narrow gauge locomotives, and that new ones are being offered by the trade at £850 to £950, Mr. Young states the Disposal Board were now quoting the figures mentioned, but no inquiries had recently been received for the locomotives. He was not, however, aware that new locomotives were now being offered by the trade at £850 to £950.

IN reply to a question in the Commons, Mr. Baldwin said: The quantities of iron and of steel produced in 1920 in the United Kingdom, the Unted States, and Germany were:—

	Pig Iron. Tons.	Steel. Tons.
United Kingdom	8,008,000	9,057,000
United States	36,403,000	40,773,000
Germany (approximate estimate)	7,000,000	9,000,000

MR. W. T. LAYTON, director of the National Federation of Iron and Steel Manufacturers, points out that one-third of the general merchandise carried on British railways consists of material for the production of the iron and steel industry. At present, while other items of cost have already fallen substantially, railway rates are at their maximum. In many cases these rates amount to as much as 20 per cent. of to-day's cost of pig-iron, and of steel to 12 per cent. The average for the country is probably 16-17 per cent. for pig-iron and 10 per cent. for steel.

A FURTHER meeting of Welsh Engineers' and Founders' Conciliation Board (Fred J. Taylor, chairman) was held with reference to reduction of wages, when it was recommended that the skilled workers' rate be reduced by 4s. as from August 1, and a further 4s. on October 3 (*pro rata* reductions for others). A meeting to be held in October to further review the position. In the event of rejection of this offer of settlement the original claim to be referred to arbitration. The delegates are submitting the matter to their constituents for consideration.

THE Australian Metal Exchange have prepared a statistical statement showing (1) the metal contents of the ores, etc., of lead, zinc, silver, copper, tin, and iron produced in Australia; (2) the recovery of refined or partially refined metal from these mine products locally treated and the metallic contents of mine products exported for refining; and (3) the refined metal and the metal contents of the mine products exported from Australia. A copy of the statement may be seen by firms interested at the Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1.

MESSRS. YATES, HAYWOOD & COMPANY, one of the oldest firms in the foundry industry in Rotherham, has established a record, which, perhaps, is unique. It has not had one slack day or had occasion to put its employés on short time during any part of the period of the twelve months' slump in trade. The firm are manufacturers of stove grates and similar productions, and by modernising their methods and remodelling the works has been enabled to book such a satisfactory run of business that not only has there been continuous full time but the state of the order books will ensure a continuance of activity for a long time ahead.

Applications for Patents.

The names of communicators are printed in italic type. A new number will be given when the Complete Specification is accepted.

Harris, H. Apparatus for refining metals. June 20. 16,871.
Meek, J. W. Furnaces. June 21. 17,017.
Mitchell, B. A. Ore-crusher. June 22. 17,099.
Neyland, T. Steel-smelting furnace repairer and feeder. June 22. 17,066.
Pickard, A. Steel binders and fasteners to hold mine, etc., railway rails in position. June 21. 16,970.
Prewett, C. G. Combined saw-bench, boring or drilling machines, and lathe. June 21. 17,035.
Schmick, H. J. Gear-cutting machines. June 20. 16,872.
Bleloch, W. E., and Stockman, H. A. Apparatus for crushing or reducing minerals, ores, etc. July 1. 17,951.
Callender's Cable and Construction Company, Limited. Manufacture of electric cables. July 2. 17,997.
Centenier, G. Tool-holder for lathes. July 2. (France, July 6, 1920.) 17,996.
Grégoire, P. J. E. Power-transmission gear. July 1. (France, July 2, 1920.) 12,901.
Pötzsche, G. Moulding-machines. June 30. 17,805.
Taylor, H. S., and W. P. Mechanical conveyors. July 2. 18,000.
Armstrong, Whitworth & Company, Limited, Sir W. G. Clamping devices for cutting-tools of lathes, etc. 18,565. July 8.
Barron, C. A. and W. Annealing, etc., of metals. 18,533. July 8.
Dandoy, F. Casting chains. 18,214. July 5. (Belgium, September 30, 1920.)
Gillott, J. C. Alloy iron. 18,263. July 6.
Liebermann, S. Apparatus for filing, smoothing, etc., metal, etc. 18,425. July 7.
Penny, F. G. Crucible furnaces. 18,453 July 7.
Utermann, F. A. Rivet-heating furnaces, etc. 18,577. July 8. (Germany, July 8, 1920.)
Woosnam, A. (Reid). Steam-boiler furnaces. 18,195. July 5.
Adam, W. G., Holmes & Company, Limited, W. C., and Cooper, C. Manufacture of sulphate of ammonia. 19,217. July 16.
Aitchison, L. Manufacture of unstainable steel and iron or alloys thereof. 19,052. July 14.
Aitchison, L., and Dyson, W. H. Purification of chromium ores and residues containing chromium oxides. 19,053. July 14.
British and Foreign Chemical Producers, Limited (*Vogel*). Pickling iron or iron alloys. 18,857. July 12.
Chemical Treatment Company, Sears, J.D., Pratt, J. T., and Jackson, D. D. Process of desulphurising iron ore, iron and steel and coke used in the metallurgy of iron. 18,891. July 12. (United States, July 13, 1920.)
Chemical and Metallurgical Corporation, Limited, and Elmore, F. E. Process for production of metallic lead from lead sulphate. 19,082. July 14.
Coke Oven Construction Company, Limited. Manufacture of neutral ammonium sulphate. 19,220. July 16.
Corbould, W. H. Process for production of oxides of copper, nickel, zinc or cobalt from their ores. 18,722. July 11.
Corbould, W. H. Process for making the bath for electrolytic deposition of copper. 18,723. July 11.
Du Pont De Nemours & Company, E. I. Ore-concentrator tables. 18,834. July 12.
Eschbach, W. Blasting-caps, and process for their manufacture. 19,271. July 16. (Germany, January 17.)
Fierz, H. E., and Prager, H. A. Production of nickel from nickel carbonyl. 19,074, 19,075. July 14.
Franchot, R., and McElroy, K. P. Blast furnaces. 19,024. July 14.
James, E. E. Slag furnaces. 18,840. July 12.
Jones, E. H. Depositing metals and alloys. 18,980 July 13.
Le Maréchal, W. H. Production of tungsten and tungsten filaments. 19,040. July 14.
Leonard, F. Tramway, etc., rails. 19,135. July 15.
Marino, Q. Electro-deposition of metals upon aluminium or its alloys. 18,970. July 13.
Perkins, W. G., Picard, H. F. K., Sulman, H. L., and Taplin, T. J. Treatment of ores containing oxidised copper compounds. 19,249. July 16.
Spirella Company. Machine for making fabricated wire. 19,254. July 16.
Tagliaferri, L. Process for obtaining steel from furnaces. 19,253. July 16.
Jones, O. D. Automatic metal-turning, etc., machines. 19,313. July 18.
Marks, A. W. File-cutting machines. 19,629. July 21.
Soanes, H. Process for extraction of copper from its ores. 19,538. July 20. (Australia, December 13, 1920.)

Company News.

Delta Metal Company is unable to pay an interim dividend on account of abnormal conditions and effect of coal strike.

Guest, Keen & Nettlefolds.—Final dividend of 1s. per share, making on ordinary 10 per cent. for the year, free of tax.

Tinsley Rolling Mills Company, Limited.—Profit, including balance brought forward £22,325 9s. 2d., dividend of 10 per cent. on ordinary.

Anthony Fasey & Son, Limited.—Capital £50,000 in £1 shares, to carry on business as engineers. Registered office: 16, Regent Street, S.W.

Branfield's Limited.—Capital £8,000 in £1 shares, to carry on the business of manufacturers of machines and tools, etc. Directors: W. Branfield and F. C. Schwab.

Lohar Machine Tool Company.—Capital £3,000 in £1 shares, to carry on the business of toolmakers, engineers, boilermakers, etc. Registered office: 76b, Phillips Street, Aston Brook, Birmingham.

Pneulec Machine Company.—Capital £5,000 in £1 shares, to take over the business of engineers and manufacturers of and dealers in machinery, carried on by P. Pritchard, H. H. B. Pearce, A. E. Pearce, and A. D. Pearce, as the Pneulec Machine Company; to acquire the licences from the said P. Pritchard of the working rights of the British patents of the Pneulec moulding machine and of the Rollover moulding and coremaking machine, together with the patents granted therefor in the U.S.A., Canada, France, or elsewhere. Registered office: Roebuck Lane, Smethwick.

Precision Machine Tool Company (Accrington).—Capital £3,000 in £1 shares, to take over the business of manufacturers of machine tools and printers' machinery carried on by B. W. Helliwell and I. Alston, at Hyndburn Works, Accrington.

J. H. Morgan, Limited.—Capital £5,000 in 2,500 8 per cent. cumulative preference shares and 1,250 "A" ordinary and 1,250 "B" ordinary shares of £1 to carry on business as steel merchants. Registered office: 57, Gracechurch Street, E.C.

Welding, Son & Company, Limited.—Capital £2,000 in £1 shares. To take over the business carried on at Liverpool as "Welding, Son and Company," and to carry on the business of general manufacturing engineers. Governing director: T. C. Welding, 6, Marine Parade, Hoylake. Registered office: 77, Vauxhall Road, Liverpool.

United Strip and Bar Mills.—First report of United Strip and Bar Mills for period to June 30, 1921, states that condition of company is satisfactory. Balance-sheet shows interest and transfer fees £19,258, less directors' fees, sundry expenses and provision for income-tax £2,717, leaving available £16,540. Preliminary expenses totalled £95,735.

Personal.

SIR GEORGE HADCOCK, K.B.E., a director of Sir W. G. Armstrong, Whitworth & Company, Limited, has joined the board of the Still Engine Company, Limited.

THE late Mr. Gilbert Edward Tennant, 25, Chesham Street, London, engineer, director of Messrs. E. Green & Sons, Limited, fuel economiser works, left £42,813.

THE late Mr. Hartley French, 3, Thornhill Crescent, Sunderland, of Messrs. G. Lamb & Sons, iron chain and anchor merchants, left estate valued at £14,610.

THE LATE MR. GEORGE STEVENSON, of The Manor House, Eckington, Derby, a director of W. Cooke & Company, Limited, steel manufacturers and wire rope makers, Sheffield, and of J. and G. Wells, Limited, The Collieries, Eckington, left £38,871.

MR. HERBERT L. CRITCHLEY, works manager of the Locomotive Works, Sir W. G. Armstrong, Whitworth & Company, Limited, Scotswood, has resigned to become general manager of the Combustion Developments Company, London.

MR. ANDREW SIMPSON, manager of the Newport branch of the Cardiff Channel Dry Dock & Pontoon Company, Limited, has retired owing to ill-health. Mr. J. L. Paynter has been appointed to succeed him; and will have with him as assistants Mr. W. Clay Taylor and Mr. Philip Willis, both of whom are officials of the company at Newport, and having also secured promotion.

ARMORDUCT BRITISH COMPANY, LIMITED (in voluntary liquidation). Claims to H. A. Pepper, 14, Temple Street, Birmingham, C.A. liquidator by August 31.

THE partnership existing between Messrs. J. H. A. Curry, H. Hanson, and J. Fletcher, trading under the style of the Theaker Lane Foundry Company, Armley, Leeds, has been dissolved, and the business will be carried on by H. Hanson and J. Fletcher.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

Stagnation is still the dominant note in pig-iron markets, and so far there have been few significant indications of any awakening of active interest on the part of consumers. Current demands, meanwhile, are being met partly by reserves of stock of lower grade quality pig, and partly by Continental iron, of which fair supplies are available from France, Belgium and Germany. The recent reduction in coke prices in the Midland area has, however, induced some of the Derbyshire ironmasters to re-start smelting operations, and at least five furnaces have been relighted in the district. Makers are proceeding cautiously, however; they are not employing their full resources. It does not appear that any definite preparations are being made for a resumption of pig-iron production in Staffordshire or Northamptonshire. In South Staffordshire, the few furnaces in action or about to be started are mostly confined to providing pigs for mills, and forges belonging to the firms manufacturing steel, and their re-starting will not increase supplies available for the open market. Smelters in this connection argue that with coke even at the reduced price of 30s. per ton will not permit the profitable employment of plants in competition with foreign makers, who are quoting much below the current prices of the home products.

Recently good foundry numbers were offered by Belgian shippers at from 130s. to 135s. In a few cases rather lower figures have been quoted; but the buyer may have to wait a month to get the iron through, and with the market in its present unsettled state this is a serious drawback. One quotation for a Derbyshire brand of foundry iron was 155s.; another was nearer 180s. In the West of Scotland it is reported that inquiries have been more numerous, but evidently consumers are not convinced that the bottom of the market has been reached. Continental production continues to find its way here in increasing quantities, and the price of certain classes of Belgian material has been raised. At Middlesbrough, although business in Cleveland iron is still stagnant, the prospects are reported brighter. The Durham coke makers do not appear to be prepared as yet to follow the lead of the Yorkshire producers who have reduced the quotation for blast-furnace coke to 30s. per ton, but Durham coke is obtainable at 35s. per ton, and the condition of the fuel market is such that further reductions seem extremely probable. In view of the more favourable outlook in fuel supplies, two hematite furnaces were to be put into operation at the week-end, but that will only make 11 in blast locally out of a total of about 72, which is the normal number. The modification in the price of No. 3 Cleveland G.M.B., which is now quoted 135s. per ton for home and export, has been followed by a steadying of the price of No. 4 foundry iron, and this quality is now available at 130s. per ton, although in most cases sellers prefer to sell equal quantities of No. 3 and No. 4 at 132s. 6d. per ton. No. 4 forge and mottled are still quoted 117s. 6d. per ton, and white iron 115s., but there is no demand, as better foreign iron can still be bought at a lower figure. As a consequence last week a cargo of 1,100 tons of Belgian pig-iron arrived in the Tees from Antwerp, and last month 485 tons of pig-iron came into the Tees from France.

East Coast hematite is firm at 160s. per ton for home consumption, and there is less on offer for export, though it might still be possible to buy for shipment at 140s. per ton. The position in the hematite industry in North Lancashire shows some slight improvement, another furnace having been put in blast bp the North Lonsdale Iron Company at Ulverston. Values, however, are unchanged, quotations ruling 175s. per ton delivered Sheffield.

Finished Iron.

In common with all branches of the iron and steel trade, business in finished material is, with the exception of marked bars, practically at a standstill, and orders in that section are by no means on a large scale. In South Staffordshire, mills are only running to a limited extent, makers of crown and the commoner qualities of bars suffering severely from Continental competition, Belgian brands especially being freely on offer at undercutting prices, which are simply out of the question where home producers are concerned. With crown bars at £16 per ton, makers contend they are even now working at a loss, and although there has been a drop in wages since the last ascertainment of 80 per cent., mill hands' wages still remain at 122½ per cent. above the basis rate. When to this is added the cost of fuel and other raw materials it is readily realised how hopeless the position is and how impossible it is for manufacturers to put up any sort of fight against foreign competition, and it is not surprising that some of the mills remain standing. It is obvious from the amount of the wages reduction that May and June saw a considerable fall in realised selling prices. The return also shows a very big fall in production, which, however, is only what was to be expected in view of the miners' strike. It would be interesting to compare the figures with those of the previous two months and with the corresponding period of 1920, but that is not now permitted. On Clydeside, malleable bar iron makers are experiencing difficulty in keeping the mills rolling. Locomotive building is dull. A like observation generally describes engineering. Few orders are taking the place of those executed.

The imports of iron, steel, etc., at Hull from abroad during the past week were:—Iron: Pig, 20 tons (Bleasdale & Company); 20 tons (Wilson's and N.E.R. Company). Bars, etc.: 8 tons (Ellerman's Wilson Line); 2 tons (Ohlsen & Company); 18 tons (Bleasdale & Company); 148 tons (Wilson's and N.E.R. Company); 348 tons (Furley & Company); 18 tons (Ruston, Hornsby & Company); 15 tons (McArthur & Company) Steels: Blooms, etc., 37 tons (Ellerman's Wilson Line); 56 tons (Furley & Company); 33 tons (Wilson's and N.E.R. Company); 5 tons (Bleasdale & Company). Goole.—Iron: Pig, 380 tons, 1,788 plates, 6,892 bars. Steel: 200 tons rails, 730 billets, 51 bars, 55 plates, 329 joists. Spelter: 2,760 ingots (order).

Steel.

Resulting from the recent decrease in production costs, implied in reductions in the prices of raw material, fuel and labour, there has been a corresponding improvement in the outlook of the steel trade, stimulated also by a better volume of inquiries in all directions, which may ultimately materialise in more active conditions than have been experienced during the past few months. For the present, however, trade remains in a state of suspended animation, as expressed in the Board of Trade returns recently issued, which show in the export figures for July, declines as follows:—Finished steel from 48,818 to 2,702 tons; special steels from 1,107 to 291 tons (and in value from £215,500 to £45,728); hoops and strips from 6,774 tons to 291 tons; galvanised sheets from 51,214 tons to 2,691 tons; tinplate from 32,616 tons to 8,827 tons; tubes and pipes from 24,000 tons to 7,000 tons; railway wheels, axles, and tyres from 6,000 tons to 3,000 tons; sleepers and fishplates, from 6,000 tons to 5,722 tons; wire from 5,000 tons to 68 tons. On the other hand, imports of the same materials went up from 81,166 tons to 103,561 tons. The steel figures show 4,616 tons of billets from Belgium, 771 tons from Germany, and 5,092 tons from other countries, the total, however, being less than half that of July last year. We also imported 10,527 tons of sheet and tinplate bars, 6,000 tons of various finished steel, 6,908 tons of plates and sheets, 2,686 tons of wire rods, 3,620 tons of rails, 141 tons of railway wheels, 3,567 tons of girders, and 3,653 tons of wire. Hand tools of various kinds have dropped on the month from £153,978 to £47,989. At Sheffield, last week, a reduction of £2 per ton on acid billets was announced, but there is no change in basic quality, and the wide disparity between the two classes of material which has obtained for a long period is lessened to the extent of the figure named. Current prices of billets and other material are now as follows: Bessemer acid, £15 10s.; Siemens' ditto, £16; hard basic, £13; soft ditto, £12; soft steel hoops, £17 5s. Works, however, are still suffering from a lack of orders, buyers holding aloof from markets in the hope of further price reductions, but as stocks held in warehouses and merchants' hands must be nearly depleted, this position cannot be possibly maintained for an indefinite period, and must ultimately bring renewed demand for home consumers. Inquiries, at all events, show symptoms of revived activity, and though plants at present are only working short time, there are sanguine hopes expressed that the end of the recent slump is actually in sight. Beyond the decline in semi-product quotations already noted, price movements disclose little change during the past week, and may be regarded as nominal for the present

Scrap.

Reports from all centres of scrap consumption emphasise extreme dulness in the trade, and until there is a revival of demand for iron and steel little improvement in business can be expected. In South Wales the market for scrap continues in a depressed condition and the quantities changing hands are small Supplies are plentiful, but prices have a firmer tendency. Heavy steel scrap is offered at from 62s. 6d

to 80s., while a few deals have been reported at between 62s. 6d. and 70s. Bundled steel scrap and shearings are quoted at 40s. to 75s., according to the method adopted in bundling. Steel turnings are 45s. to 55s., mixed wrought iron and steel scrap for basic furnaces is plentiful, and holders are experiencing great difficulty in obtaining any offers for their material. Prices are low and range from 20s. to 70s., according to quality. Heavy cast-iron scrap in large pieces is a little more active at 60s. to 80s. Good machinery scrap for foundry purposes is in better request at about £6. At Middlesborough the steel scrap price is nominal at about £2 10s. per ton. There are very few inquiries for heavy iron or bushelling iron, the price being nominal at about £3 to £3 5s. per ton. There has been practically nothing done in heavy cast iron for some time, except in small quantities, and for good machinery quality in handy pieces the price is nominal at about £5 10s. to £5 15s. per ton delivered in works.

Ore.

On Tees-side the foreign ore trade is still idle, and likely to remain so until there is a much more general resumption at the furnaces, but in the meantime a figure as low as 29s. per ton has been mentioned for best rubio ore. In the native iron-ore industry labour has shown itself willing to make sacrifices, as witness the drastic wage cut accepted by the Cleveland miners, who, it is stated, will in some cases suffer a reduction of 8s. a day as compared with last November.

It is estimated that during 1920, 13,871,187 metric tons of iron ore were mined in France, as compared with 9,429,789 metric tons in 1919, which shows an increase of 4,441,398 metric tons in 1920 over the production of 1919, or 47 per cent. In 1913 the French production of iron ore totalled 21,917,870 metric tons, and to this amount should be added 21,136,265 metric tons mined in the Metz-Thionville basin, which was then under German control.

Tinplates.

Business in the tinplate market continues on restricted lines, and although resumption of work at the mills is now becoming fairly general, it is understood that production for the time being is principally confined to plates for stock. In some quarters the fact that France is now able to obtain ample supplies of iron ore from the newly-acquired mines in Alsace-Lorraine, and the fact that Norway is setting up its own tinplate works, mean serious competition in the Welsh markets on the Continent unless costs come down in this country. In this connection a substantial drop in the wages of the Welsh tinplate operatives came into operation last week, as a result of the average price of bars for the period April to June. It is understood that the new rate for the next three months will be 45 per cent., which on the base, plus the 25 per cent. consolidated rate, equals 81½ per cent., as against 131½ per cent. ruling for the past three months. Under the proposed new Spanish import tariff the rate imposed on tinplates of British manufacture will be 24 pesetas per 100 kilogs, against 25 pesetas per 100 kilogs in the previous tariff. Plates for prompt delivery are now becoming more plentiful, and prices have fallen in consequence. Buyers are not anxious even at 24s., which is now being quoted for quick delivery. For shipment over the last quarter of the year 23s. is generally quoted for approved specifications in coke finish, net cash, f.o.t. at works, but, although there has been more inquiry, very little business has actually resulted. Wasters are in moderate demand. Full weight 28 x 20 are quoted 40s. to 41s. per box; CW 14 x 20, 20s. per box; but 14 x 18¾ do not realise more than 16s. per box. Light weights are in request for Eastern markets, and as they are scarce, prices in most instances are higher than those ruling for full weights. Terneplates are easy at 22s. basis for September-October. There is a very poor demand, however, and even less than this would probably be accepted for a good straight line. Makers will have difficulty in keeping their mills going unless trade quickly improves.

Metals.

Copper.—Quiet conditions continue to prevail in the standard copper market, with fluctuations in value within very narrow compass. There has, however, been, perhaps, a little more disposition on the part of consumers to come into the market, though the quantities disposed of have been only of limited volume. On the Continent, Germany is the best buyer, and in America it seems to be anticipated that the arrangement of German credits in the United States will enable increased purchases to be made. Business at Monday's opening market was fairly active with offers of both cash and three months being well absorbed. Values at the close showed a slight appreciation in both positions. Electrolytic and wire bars were steady at £74 to £75, showing a small decline. Closing prices:—Cash: Wednesday, £70 2s. 6d.; Thursday, £70; Friday, £69 15s.; Monday, £69 17s. 6d.; Tuesday, £69 10s. Three months: Wednesday, £70 10s.; Thursday, £70 5s.; Friday, £70; Monday, £70 5s.; Tuesday, £69 17s. 6d.

Tin.—The week's markets for tin opened with weaker Eastern advices, giving a further decline of £3, with sales to date at £158 15s. c.i.f. The drooping tendency in tin values noted towards last week's close was continued, and in the absence of consumers' demands prices again weakened. The Continental demand has not as yet revived again, although America buys a little now and again, but such purchases are hardly worth mentioning when it is considered what the takings of the United States ought to be. Meanwhile the East sells steadily. There is no sign of China selling yet, and the position in regard to stocks there is rather obscure. Business comprised August at £155 10s.; September, £156 and £155 15s.; October, £156 10s. down to £155 15s. Settlement price, £155 5s. English ingots nominally £154. Batavia shipments during July totalled 1,228 tons, including 452 tons of Banca and 242 tons of Billiton to the United Kingdom. Whilst the whole outlook cannot be regarded as satisfactory from the point of view of the holder of tin, what must be borne in mind is that the present price is already a very moderate one. Closing prices:—Cash: Wednesday, £159 5s.; Thursday, £157; Friday, £155 5s.; Monday, £155 5s.; Tuesday, £154 15s. Three months: Wednesday, £161 5s.; Thursday, £158 10s.; Friday, £156 5s.; Monday, £156 10s.; Tuesday, £156.

Spelter.—The week's market for spelter opened quietly, the day's turnover only amounting to 250 tons. There are, however, signs of an improved demand for spelter on the part of consumers, but the demand is still exceedingly small, and not sufficient to have a material effect upon prices. The price has shown some unsteadiness of late, with a tendency to weakness. Business done comprised: August at £23 12s. 6d.; September, £23 10s.; October, £23 7s. 6d.; and November, £23 2s. 6d. Closing prices, ordinary brands: Wednesday, £26; Thursday, £25 15s.; Friday, £25 15s.; Monday, £25 10s.: Tuesday, £25 10s.

Lead.—Recently there has been a falling-off in the demand for lead, which has led to a drooping tendency in the price, but the fall has not been severe. It is stated that near metal appears to be strongly held. English closing prices: Wednesday, £25; Thursday, £24 15s.; Friday, £24 15s: Monday, £24 15s; Tuesday, £24 15s.

Publications Received.

MESSRS. CHARLES W. HOBSON, 3, St. James's Square, Manchester. "Road Reinforcement," fifteenth issue, July 1921.

THE STANTON IRONWORKS COMPANY, LIMITED, near Nottingham.—Catalogue describing "Stanton Hume" reinforced concrete pipes for working pressures up to 100 lbs. per sq. in.

The
ELLISON CATALOGUE
of Electric Control Gear.
gives full particulars, capacities, dimensions and prices of ELLISON CONTROL GEAR. Please ask for List No. 100.
GEORGE ELLISON, PERRY BARR, BIRMINGHAM.

LIMESTONE for FLUXING
98% Calcium Carbonate
Ideal for Metallurgical purposes. Can commence deliveries immediately.
LARGE CONTRACTS ARRANGED.
LECKHAMPTON QUARRIES CO., LD.
CHELTENHAM. GLOS.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d
Standard cash	69	10	0
Three months	69	17	6
Electrolytic	73	10	0
Tough	69	15	0
Best selected	69	15	0
Sheets	103	0	0
India	103	0	0
Wire bars	74	5	0
Do. Sept.	74	5	0
Do. Oct.	74	5	0
Ingot bars	71	5	0
H.C. wire rods	82	10	0
Off. aver. cash, July 71	4	4½	
Do. 3 mths., July 71	9	5½	
Do. Settlement Jul. 71	4	3½	
Do. Electro, July 76	0	8½	
Do. B.S., July 72	11	1½	
Aver. spot, copper, July	71	3	8½
Do. Electro, July	76	1	11

Solid drawn tubes 14½d.
Brazed tubes 14½d.
Wire 11d.
Yellow metal rods 8d
Do. 4x4 Squares 9½d.
Do. 4x3 Sheets 9½d

BRASS.

Solid drawn tubes 12½d.
Brazed tubes 15½d.
Rods 11½d.
Sheets to 10 w.g. 11½d.
Wire 11½d.
Rolled metal 10½d.

TIN.

	£	s.	d
Standard cash	154	15	0
Three Months	156	0	0
English	154	0	0
Bars	156	0	0
Chinese	150	0	0
Straits	155	15	0
Australian	155	15	0
Eastern	158	15	0
Banca	156	15	0
Off. aver., cash, July 164	13	1½	
Do. 3 mths., July 166	15	0	
Do. Sttlment., Jul. 164	12	10½	
Aver. spot, July	164	11	8

SPELTER.

	£	s.	d
Ordinary	25	7	6
Remelted	22	0	0
Hard	16	0	0
Electro 99.9	33	15	0
English	32	0	0
India	20	0	0
Prime Western	26	7	6
Zinc dust	45	0	0
Zinc ashes	5	5	0
Off. aver., July	26	12	0½
Aver., spot, July	26	5	3

LEAD.

	£	s.	d
Soft foreign ppt	24	5	0
English	24	15	0
Off. average, July	23	5	10
Average spot, July	23	7	11½

ZINC SHEETS.

	£	s.	d
Zinc sheets, spot	35	0	0
Do. V.M. ex whf.	36	0	0
Do. ppt., f.o.b., N.Y.			—
Dutch	35	10	0
Boiler plates	33	0	0
Battery plates	32	10	0

ANTIMONY.

	£	s.	d
English regulus	37	0	0
Special brands	42	0	0
Chinese	25	0	0
Crude	18	0	0

QUICKSILVER.

Quicksilver 10 10 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d
Ferro-silicon—			
45/50%	14	0	0
75%	21	0	0
Ferro-vanadium—			
35/40%	22/- lb. va.		
Ferro-molybdenum—			
70/80%	9/- lb. mo.		
Ferro-titanium—			
23/25%, carbonless	1/6 lb.		
Ferro-phosphorus, 20/23%	£28		
Ferro-tungsten—			
80/85%, carbon free	1/6 lb.		
Tungsten metal powder—			
98/99%	1/11 lb.		
Ferro-chrome—			
4/6% car.	£36		
6/8% car.	£35		
8/10% car.	£34		
Ferro-chrome—			
Max. 2% car.	£80		
Max. 1% car.	£95		
Max. 0.75% car.	£110		
65/75%, carbonless	2/8 lb.		
Nickel—99·8%, cubes or pellets	£190		
Cobalt metal—97%	15/- lb.		
Aluminium—98/99%	£115		
Metallic Chromium—			
98/99%	5.6 lb.		
Ferro-manganese—			
76/80%, loose	£18		
76/80%, packed	£19		
76/80%, export	£14		
Metallic manganese—			
98/99%, carbonless	2/9 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	0
Finished bars, 18% tungsten	3	9

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ⅛ in. to ¼ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing 5s. cwt
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 5d.
Turnings and swarf 2d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.
Heavy Steel	3	5	0
Bundled steel & shearings	2	17	6
Mixed iron & steel 1 0 0	3	10	0
Heavy cast iron	3	10	0
Good machinery for foundries	6	0	0
Cleveland—			
Heavy steel	2	10	0
Steel turnings	1	10	0
Cast-iron borings	2	2	6
Heavy wrought iron piling	3	0	0
Bundling scrap	3	2	6
Cast-iron scrap	5	15	0
Lancashire—			
Cast iron scrap	6	10	0
Heavy wrought	3	0	0
Steel turnings	2	5	0

London—	£	s.	d.
Copper (clean)	51	0	0
Brass (clean)	28	0	0
Lead (less usual draft)	18	0	0
Tea lead	16	0	0
Zinc	11	10	0
New aluminium cuttings	60	0	0
Braziery copper	43	0	0
Gun metal	43	0	0
Hollow pewter	125	0	0
Shaped black pewter	75	0	0

PIG-IRON.

(Premiums required for foundry).

N. E. Coast—	
Foundry No. 1	—
Foundry No. 3	135/-
Forge No. 4	117/6
Mottled	117/6
Hematite No. 1	162/6
Hematite M/Nos.	160/-
Midlands—	
Staffs. common	145/-
„ part-mine forge	160/-
„ „ foundry	180/-
„ Cold blast	—
„ basic	—
Northants forge	130/-
„ foundry No. 3	150/-
„ basic	—
Derbyshire forge	150/-
„ foundry No. 3	165/-
„ basic	—
Scotland—	
Foundry No. 1	185/-
„ No. 3	180/-
Hematite M/Nos.	180/-
Sheffield (d/d district)—	
Derby forge	—
„ foundry No. 3	—
„ basic	—
Lincs. forge	160/-
„ foundry No. 3	170/-
„ basic	—
E.C. hematite	173/-
W.C. hematite	175/-

All d/d in the district.

Lancashire (d/d eq. Man.)—	
Derby forge	—
„ foundry No. 3	175/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
„ foundry No. 3	—
Summerlee foundry	200/-
Glengarnock foundry	202/6
Gartsherrie foundry	200/-
Monkland foundry	200/-

FINISHED IRON & STEEL.

Iron—	£	s.	d.
Bars (crown)	16	0	0
Angles	16	10	0
Tees to 3 united ins.	17	0	0
Nut and bolt	16	0	0
Hoops	20	5	0
Marked bars (Staffs.)	20	0	0
Gas strip	20	0	0
Bolts and nuts, ¾ in. × 4 in.	34	0	0
Steel—			
Ship plates	15	0	0
Boiler plates	21	0	0
Chequer plates	15	10	0
Angles	14	10	0
Tees	15	10	0
Channels	14	15	0
Joists	14	10	0
Rounds, ½ in.–3-in.	14	0	0
Rounds, 3 in.–5½ in.	13	10	0
Flats, 5 in.–8 in.	15	0	0
Flats over 8 in.	15	0	0
Rails, heavy	14	0	0
Fishplates	19	0	0
Hoops	15	0	0
Black sheets, 24 g.	17	10	0
Galv. cor. sheets, 24 g.	21	10	0
Galv. fencing wire, 8 g. plain	19	10	0
Rivets, ¾ in. dia	24	0	0
Billets, soft	9	10	0
Billets, hard	10	10	0
Sheet and tin bars	8	10	0

PHOSPHOR BRONZE.

	Per lb basis.
Strip	1 6
Sheet	1 7
Wire	1 6½
Rods	1 5¾
Tubes	1 8½
Castings	1 3½

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/1 to 1/7
Rolled—	
To 9 in. wide	1/8½ to 2/2½
To 12 in. wide	1/9 to 2/3
To 15 in. wide	1/10 to 2/4
To 18 in. wide	1/11 to 2/5
To 21 in. wide	2/- to 2/6
To 24 in. wide	2/1 to 2/7
Ingots for spoons and forks	1/1 to 1/7
Ingots rolled to spoon size	1/4 to 1/10
Wire round—	
3/0 to 10. G.	1/11 to 2/6

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21.35
No. 2 foundry Valley	19.50
No. 2 foundry, Birm.	19.50
Basic	19.96
Bessemer	21.96
Malleable	21.46
Grey forge	21.46
Ferro-manganese 80 % delivered	70.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	30.00
O.-h. billets	30.00
O.-h. sheet bars	32.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.10
Steel bars	1.75
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.40
Sheets, black, No. 28	3.00
Sheets, galv., No. 28	4.00
Sheets, blue an'l'd, 9&10	2.45
Wire nails	2.75
Plain wire	2.50
Barbed wire, galv.	3.40
Tinplate, 100-lb. box	$5.25

COKE.

Welsh foundry	—
„ furnace	—
Durham & North foundry	53/-
„ furnace	37/6
Other Districts, foundry	60/-
„ furnace	30/-